Digitized by the Internet Archive
in 2010 with funding from
Natural History Magazine, Inc.

http://www.archive.org/details/naturalhistory3615newy

NATURAL HISTORY

THE JOURNAL OF THE
AMERICAN MUSEUM OF NATURAL HISTORY

VOLUME XXXVI

June, September-December, 1935

TEN ISSUES A YEAR

Published by
THE AMERICAN MUSEUM OF NATURAL HISTORY
NEW YORK, N. Y.

CONTENTS OF VOLUME XXXVI

June, No. 1

The Gyrfalcon Strikes ... Cover
"Shiprock" ... Frontispiece
Sinclair Dinosaur Expedition, 1934 ... Barnum Brown 3
Bronze Artists of West Africa ... Laura C. Boulton 16
A Contribution to Maya Architecture ... Clarence L. Hay 29
The Four-eyed Fish ... G. Kingsley Noble 34
Exploring the "Mighty Chindwin" ... Arthur S. Vernay 37
Winged Monarchs of the Air ... George G. Goodwin 51
Weaving in the Land of the Incas ... Wendell C. Bennett 62
Friday Harbor's Nets and Dredges ... Harriet Geithmann 73
Science in the Field and Laboratory ... 81
Reviews of New Books ... 85

September, No. 2

Aërial Photography in the Southwest ... Cover
In the Valley of the Big Horn ... Frontispiece
Flying for Dinosaurs ... Barnum Brown 95
Living Honey Jars ... A. C. Cole, Jr. 117
Fishes in Armor ... Myron Gordon 124
A Whale Shark in the American Museum ... E. W. Gudger 128
To the Strange "Buttons" ... Alfred O. Gross 133
Konrad Gesner Was Right ... Willy Ley 149
Buffalo Hunt—1935 ... George G. Goodwin 156
Salamanders ... Charles E. Mohr 165
Science in the Field and in the Laboratory ... 174
Reviews of New Books ... 177

October, No. 3

An Impression of The Hayden Planetarium ... Cover
Charles Hayden ... Frontispiece
Foreword ... F. Trubee Davison 187
The Hayden Planetarium ... 188
Exploring in Space ... 195
Problems of Construction ... Wayne M. Faunce 207
Astronomical Fiction ... Frank C. Jordan 217
The Birth of the Solar System ... Clyde Fisher 220
Ancient Man and His Universe ... Marion Lockwood 229
Glimpses Into Relativity ... Clyde Fisher 235
The Calendar Through the Ages ... Frederick Slocum 247
Cosmic Rays ... W. F. G. Swann 255
The Mysterious Moon ... Dorothy A. Bennett 262
Science in the Field and in the Laboratory ... 266
Reviews of New Books ... 271

November, No. 4

African Gemsbok ... Cover
Hunting with Poisoned Dart and Blowgun ... Frontispiece
Curari—The Flying Death ... Richard C. Gill 279
To Polynesia on the Yacht "Zaca" ... James P. Chapin 293
The Making of a Cayuco ... Frank M. Chapman 311
An Animal from a Lost World ... George Gaylord Simpson 316
Swordfish Lore ... Myron Gordon 319
How Many Marlin Are There? ... J. T. Nichols and F. R. LaMonte 327
Rattlesnakes ... C. H. Curran 331
Nature's Palaces ... Russell T. Neville 341
The Great Auk ... Willy Ley 351
Science in the Field and in the Laboratory ... 358
Reviews of New Books ... 364

December, No. 5

Polar Bear of the Arctic ... Cover
Henry Fairfield Osborn, 1857—1935 ... W. K. G. 370
An Equatorial Wonderland ... Joseph R. Slevin 374
The Golden Diggers ... Roy L. Abbott 389
The Ancient Buried City of Kentucky ... Lorine Letcher Butler 398
Attacking Ocean Problems ... George L. Clarke 405
Across Newfoundland ... Stanley Truman Brooks 417
A Strange Partnership ... Don H. Selchow 431
A National Park in Embryo ... C. S. Pulver 438
Science in the Field and Laboratory ... 445
Reviews of New Books ... 453

INDEX TO VOLUME XXXVI

TEXT AND ILLUSTRATIONS

Names of Articles Are Set in Capitals and Small Capitals

- Abbott, Roy L: The Golden Diggers, 389–397
- Across Newfoundland, Stanley Truman Brooks, Illustrated, 417–430
- Aërial Photography in the Southwest, Cover Design, September
- African Gemsbok, Cover Design, November
- Akéley, Mary L. Jobe, 175
- Ancient Buried City of Kentucky, The, Lorine Letcher Butler, Illustrated, 398–404
- Ancient Man and His Universe, Marian Lockwood, Illustrated, 229–234
- Andrews, Roy Chapman, 267
- Animal From a Lost World, An, George Gaylord Simpson, Illustrated, 316–318
- Anthropological papers, 451
- Astronomical Fiction, Frank C. Jordon, 217–219
- Astronomy:
  - Amateur Astronomers Association, 82; 174; 266; 358; 447
  - Einstein theory, 82; 235–246
  - Fiction in, 217–219
  - Hayden Planetarium, 174; 188–194; 207–216; 266; 447
  - Junior Astronomy Club, 174
  - Moon, 262–265
  - Planet notes, 82
  - Pleiades, 82
  - Solar system, 220–228
- Attacking Ocean Problems, George L. Clarke, Illustrated, 405–416

- Bennett, Dorothy A: The Mysterious Moon, 262–265
- Bennett, Wendell C: Weaving in the Land of the Incas, 62–72
- Birds:
  - Alpine group, American Museum, 268
  - Falcons, 51–61
  - Great auk, 351–357
  - Honey guide, 431–437
  - Whitney wing, American Museum, 268
- Birth of the Solar System, The, Clyde Fisher, Illustrated, 220–228
- Book Shop, American Museum, 176
- Book Reviews:
  - *Adventures of Sajo and Her Beaver People, The*, 453
  - *Along the Hill*, 455
  - *Anthropology in Action*, 272
  - *Arachnida, The*, 364–365
  - *Back-yard Zoo*, 179
  - *Bird Portraits in Color*, 86
  - *Cities of Wax*, 453
  - *Comparative Psychology*, 273–274
  - *Diary of the Alarcón Expedition into Texas*, 87
  - *Earth Among the Stars, The*, 271
  - *Empire of the Snakes, The* 179
  - *Exotic Aquarium Fishes*, 272–273
  - *Fish and Game—Now or Never*, 454–455
  - *Fishes and Their Ways of Life*, 273
  - *Handbook of Travel*, 86
  - *Hawks of North America, The*, 178
  - *Heels, Wheels, and Wire*, 455
  - *Horizon's Rim*, 366
  - *How To Ride Your Hobby*, 274
  - *Human Foot, The*, 453
  - *Leaves from a Greenland Diary*, 366
  - *Manual of the Land and Fresh Water Vertebrate Animals of the United States*, 365
  - *Manual of the Southeastern Flora*, 177
  - *Men Against the Clouds*, 180
  - *Oceanic Birds of South America*, 272
  - *Pacemakers in Relation to Aspects of Behavior*, 364
  - *Plants of the Vicinity of New York*, 85–86
  - *Pony Express Goes Through, The*, 455
  - *Progress of Archæology*, 85
  - *Radio Round the World*, 86
  - *Reptiles of China, The*, 177
  - *Relativity, Gravitation, and World Structure*, 271
  - *Richards Cyclopedia*, 274–275
  - *Singing in the Wilderness*, 365
  - *Snake Hunter's Holiday*, 367
  - *Story of an African Chief, The*, 181
  - *Tales of Sint Sink*, 456
  - *Tarahumara, The: An Indian Tribe of Northern Mexico*, 179–180
  - *Three Dollars a Year*, 366
  - *Von Ottern und Nattern, Ein Schlangenbuch*, 367
  - *When the Stars Come Out*, 85
  - *Wild Birds at Home*, 178
- Boulton, Laura C: Bronze Artists of West Africa, 16–28
- Bronze Artists of West Africa, Laura C. Boulton, Illustrated, 16–28
- Brooks, Stanley Truman: Across Newfoundland, 417–430
- Brown, Barnum: Sinclair Dinosaur Expedition, 1934, 3–15; Flying for Dinosaurs, 95–116; 176
- Buffalo Hunt—1935, George G. Goodwin, Illustrated, 156–164
- Buffalo Museum, 84
- Bulletin, American Museum, 87; 181; 367
- Butler, Lorine Letcher: The Ancient Buried City of Kentucky, 398–404

- Calendar Through the Ages, The, Frederick Slocum, Illustrated, 247–254
- Castillo cave model, 83–84
- Caves, 341–350
- Chapin, James P: To Polynesia on the Yacht "Zaca," 293–310; 84
- Chapman, Frank M: The Making of a Cayuco, 311–315
- Chubb, S. H., 362
- Clarke, George L: Attacking Ocean Problems, 405–416
- Cole, A. C. Jr: Living Honey Jars, 117–123
- Conrad, G. Miles, 175–176; 362
- Contribution to Maya Architecture, A. Clarence L. Hay, Illustrated, 29–33
- Cosmic Rays, W. F. G. Swann, Illustrated, 255–261
- Curari—The Flying Death, Richard C. Gill, Illustrated, 279–292
- Curran, C. H: Rattlesnakes, 331–340

- Davison, F. Trubee, 187
- Dean Memorial Library, 176
- Denison, Robert H., 362
- Dust, samples of, 83

- Education:
  - American Museum activities, 82–83; 174–175; 360–361; 448
  - Bear Mountain Nature Trails, 267–268
  - Botanical lectures, 270
- Embich, John R., 176
- Equatorial Wonderland, An, Joseph R. Slevin, Illustrated, 374–388
- Evans, Francis Gaynor, 362
- Expeditions:
  - American Museum-Cornell University, 359
  - Bowdoin-MacMillan, Arctic, 133–148
  - Crocker, South Seas, 293–310; 446–447
  - Davison, Alberta, 445
  - Frick, Nevada, 445
  - Hassler, Hispaniola, 81; 445
  - Morden, Honolulu, 81
  - Scarritt, Montana, 81
  - Scarritt, Patagonian, 316–318
  - Sinclair, Dinosaur, 3–15; 96–116
  - Snyder, Canadian, 156–164; 358
  - Snyder, Colorado, 445
  - Vernay-Hopwood, Chindwin, 37–50; 266–267
- Exploring the "Mighty Chindwin," Arthur S. Vernay, Illustrated, 37–50
- Exploring in Space, 195

- Faunce, Wayne M: Problems of Construction, 207–216
- Fish:
  - Aquarium Society exhibit, 270
  - Colors of, 84
  - Fossil, 361–362
  - Four-eyed, 34–36
  - Madagascar, 268; 363
  - Marlin, 327–330
  - Porcupine, 124–127
  - Skipjacks, 268
  - Swordfish, 319–327
  - Tuna, 84
  - Whaleshark, 84; 128–132
- Fisher, Clyde: The Birth of the Solar System, 220–228; Glimpses Into Relativity, 235–246
- Fishes in Armor, Myron Gordon, Illustrated, 124–127
- Fleischmann, Max C., 446
- Flying for Dinosaurs, Barnum Brown, Illustrated, 95–116
- Four-eyed Fish, The, G. Kingsley Noble, Illustrated, 34–36
- Friday Harbor's Nets and Dredges, Harriet Geithmann, Illustrated, 73–80
- Frost, Edwin B., 82

- Galápagos Islands, 374–388
- Geithmann, Harriet: Friday Harbor's Nets and Dredges, 73–80
- Gill, Richard C: Curari—The Flying Death, 279–292
- Glimpses Into Relativity, Clyde Fisher, Illustrated, 235–236
- Golden Diggers, The, Roy L. Abbott, Illustrated, 389–397
- Goodwin, George G: Winged Monarchs of the Air, 51–61; Buffalo Hunt—1935, 156–164
- Gordon Myron: Fishes in Armor, 124–127; Swordfish Lore, 319–326

INDEX TO VOLUME XXXVI

Great Auk, The, Willy Ley, Illustrated, 351–357
Greely, Adolphus W., 360
Gregory, William K: Henry Fairfield Osborn (1857–1935), 370–373; 175; 362
Gross, Alfred O: To the Strange "Buttons," 133–148
Gudger, E. W: A Whale Shark in the American Museum, 128–132; 176
Gyrfalcon Strikes, The, Cover Design, June

Hay, Clarence L: A Contribution to Maya Architecture, 29–33
Hayden, Charles, 186
Hayden Planetarium, The, 188–194; 207–216
Hatt, Robert T., 175; 270
Hellman, Milo, 176
Henry Fairfield Osborn (1857–1935), W. K. G., 370–373
Hodge, Frederick Webb, 451
Howells, William, 359
How Many Marlin Are There? J. T. Nichols and F. R. LaMonte, Illustrated, 327–330

Impression of the Hayden Planetarium, An, Cover Design, October
Insects:
  Golden digger wasps, 389–397
  Honey ants, 117–123
  "Local" insects, 268–269
  Scorpions and spiders
International Nature Photography Exhibition, 83

Konrad Gesner Was Right, Willy Ley, Illustrated, 149–155

LaMonte, F. R: How Many Marlin Are There? 327–330
Ley, Willy: Konrad Gesner Was Right, 149–155; The Great Auk, 351–357
Living Honey Jars, A. C. Cole, Jr., Illustrated, 117–123
Lockwood, Marian: Ancient Man and His Universe, 229–234

Making of a Cayuco, The, Frank M. Chapman, Illustrated, 311–315
Mammals:
  Honey badger, 431–437
  North American, 359
Man:
  African natives, 16–28
  Indians, American Northwest, 269–270
  Peruvians, early, 62–72
Maya temple, 29–33
Mohr, Charles E: Salamanders, 165–173
Mysterious Moon, The, Dorothy A. Bennett, Illustrated, 262–265

National Park in Embryo, A, C. S. Pulver, Illustrated, 438–444
Nature's Palaces, Russell T. Neville, photographic series, 341–350
Nelson, N. C., 450
Neville, Russell T: Nature's Palaces, 341–350
Newfoundland, 417–430
New York Academy of Sciences, 450
Nichols, J. T: How Many Marlin Are There? 327–330
Noble, G. Kingsley: The Four-eyed Fish, 34–36
Novitates, 87; 181; 275; 367; 451

Oceanographic work, 73–80; 405–416
Osborn, Henry Fairfield, 370–373; 445

Peary, Robert E., 449
Pinkley, George, 176; 362
Poe, David L., 176
Poison, primitive, 279–292
Polar Bear of the Arctic, Cover Design, December
Pope, Clifford H., 84
Problems of Construction, Wayne M. Faunce, Illustrated, 207–216
Pulver, C. S: A National Park in Embryo, 438–444

Rattlesnakes, C. H. Curran, Illustrated, 331–340
Reptiles and amphibians:
  Chindwin, 270
  Rattlesnakes, 331–340
  Salamanders, 165–173
Rockwell, Helen, 362
Root, R. W., 448

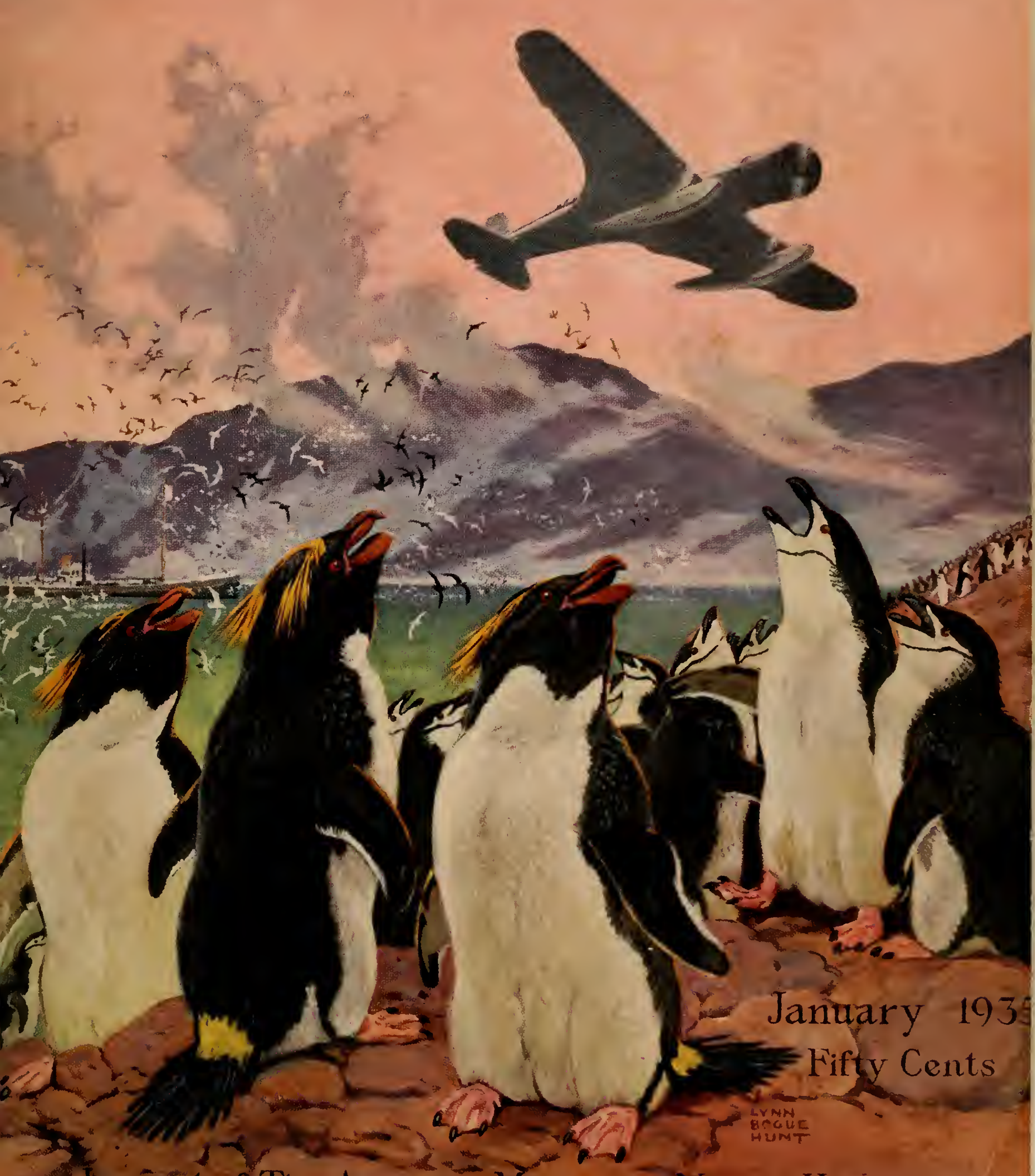
Salamanders, Charles E. Mohr, Illustrated, 165–173
Selchow, Don H: A Strange Partnership, 431–437
Shear, Leslie, 269
Sheldon, Frederick, 176
Shoemaker, Ernest, 450
Simpson, George Gaylord: An Animal from a Lost World, 316–318
Sims, Barbara, 176; 362
Sinclair Dinosaur Expedition, 1934, Barnum Brown, Illustrated, 3–15
Slevin, Joseph R: An Equatorial Wonderland, 374–388
Slipher, V. M., 82
Slocum, Frederick: The Calendar Through the Ages, 247–254
Snyder, Harry, 362
Strange Partnership, A, Don H. Selchow, Illustrated, 431–437
Swann, W. F. G: Cosmic Rays, 255–261
Swordfish Lore, Myron Gordon, Illustrated, 319–326

To Polynesia on the Yacht "Zaca," James P. Chapin, Illustrated, 293–310
To the Strange "Buttons," Alfred O. Gross, Illustrated, 133–148

Vernay, Arthur S: Exploring the Mighty Chindwin, 37–50

Weaving in the Land of the Incas, Wendell C. Bennett, Illustrated, 62–72
Whale Shark in the American Museum, A, E. W. Gudger, Illustrated, 128–132
Winged Monarchs of the Air, George G. Goodwin, Illustrated, 51–61
Wissler, Clark, 269–270

NATURAL HISTORY


LYNN
BOGUE
HUNT

January 193

Fifty Cents

Journal of The American Museum of Natural History

CHURCH AT RANCHOS DE TAOS, NORTH OF OLD SANTA FÉ

Old Santa Fé New Mexico

OLD SANTA FÉ, set 7,000 feet up in the New Mexico Rockies, and apart from modern rush and roar, is one of those rare and intriguing spots on the American map where the flavor of other days and lands lingers happily on. A capital for three centuries, under three flags, more Spanish than English is spoken on its winding, 'dobe-lined streets, in its walled gardens and patios. History and tradition lurk at every turn.

Roundabout are primitive colonial-Spanish mountain villages, old Spanish missions, Indian pueblos where archaeology can be "caught alive;" unnumbered prehistoric ruins.

Winter and summer, the sparkling, sunny climate is a joy. And facing the plaza is La Fonda, as charming and unique an hostelry as world-wandering will disclose.

At a word, it will be a pleasure to tell you more of Old Santa Fé

W. J. BLACK, P.T. M., Santa Fe Sys. Lines, 1292 Railway Exchange, Chicago

Santa Fe

Living in New York?

Check on the merits of the Prince George Hotel. Lots of educators and scientists stay here. Perhaps you will like it, too.

- Convenient to the Museum by either subway or "el."
- Complete — 1000 rooms with bath. 5 restaurants. Tap room. Radio rooms. Sun roof. Library.
- Environment — Visit us and see what we mean.
- Economical — Daily rates; room with private bath for one from $2; for two from $3.
  Monthly rates from $45 for room and private bath.
  Meals range in price from 40 cents.

Send for new booklet N

PRINCE GEORGE HOTEL

Alburn M. Gutterson, Manager

27th to 28th Streets (just off Fifth Avenue)

New York

Variety

Variation is wider in dogs than in any other animal. They differ vastly in size, weight, color shape and proportion. Domestication is largely responsible for this variation in spite of which the dog maintains a high quality. The variety of effects obtainable by the photo-engraving method of reproduction and it's latitude for all printing surfaces gives it the first consideration where quality presswork is demanded. The illustrations in this book are printed from "Sterling" engravings.

•

STERLING ENGRAVING COMPANY, NEW YORK, N. Y.

304 EAST FORTY-FIFTH STREET

MUrray 4-0715 to 0726

NATURAL HISTORY

The Journal of the American Museum of Natural History

CONTENTS

Volume xxxv, No. 1 January, 1935

Antarctic Exploration .... *Cover*
From a Painting by Lynn Bogue Hunt (See Pages 77–80)

The Age of Iron .... *Frontispiece*

Witchcraft Among the Zulus .... Carl von Hoffman 3
How Belief in the Supernatural Influences a Primitive People

Iron .... Thomas T. Read 17
The Story Behind One of the World's Greatest Industries

A Trailside Tenderfoot .... William H. Carr 27
A Cigar-maker's Experiences at the Trailside Museum on the Hudson River

Nebraska—Fifteen Million Years Ago .... Edwin C. Colbert 37
"Big Game Fields" of the Miocene

Keeping Time .... Frederick Hellweg 47
The Intricate Studies and Equipment Upon Which the Accuracy of Our Timepieces Is Based

A Summer Home in Main Street .... Herbert S. Ardell 62
Purple Martins in an Urban Bird House

Machu Picchu .... Wendell C. Bennett 64
A Famous Inca Ruin Cleared by the Peruvian Government in Celebration of the Discovery of Peru

The Ellsworth Antarctic Expedition 77
The Difficulties Besetting the Present Attempt to Cross the South Polar Continent

Science in the Field and in the Laboratory 81
Current Events in the World of Natural Sciences

Reviews of New Books 88
Recent Publications for Those Interested in Nature

HAWTHORNE DANIEL
Editor

A. KATHERINE BERGER
Associate Editor

NATURAL HISTORY—Publication Office, 10 Ferry Street, Concord, New Hampshire
Subscriptions should be addressed to The Treasurer, The American Museum of Natural History, 77th Street and Central Park West, New York, N. Y. NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership, $2.10 of the annual amount received from each membership being applied to the year's subscription to the magazine. GEORGE L. ALPERS, Advertising Manager, Advertising Office, The American Museum of Natural History, 77th Street and Central Park West, New York, N. Y. Copyright, 1935, by The American Museum of Natural History, New York

Courtesy of the U. S. Steel Corporation

The Age of Iron

Within the past hundred years the smelting of iron and the production of steel have grown into one of mankind's major activities. Where formerly iron and steel were very widely used, but in small quantities, they are now produced in gigantic quantities and used everywhere. The converter shown in this photograph is transforming iron into steel

(See " Iron," Page 17)

NATURAL
HISTORY
January, 1935

Witchcraft Among the Zulus

So firmly do the Zulus believe in the supernatural power of witches and witch-doctors, that witchcraft seems to play an actual as well as an imaginary part in their everyday lives

by Carl von Hoffman

Copyrighted Photographs by the Author

THOUGH long acquainted with white men, and influenced in countless ways by civilization, the Zulu still clings to his belief in the supernatural powers of witches and witch-doctors, who play a large part in the life of Zululand.

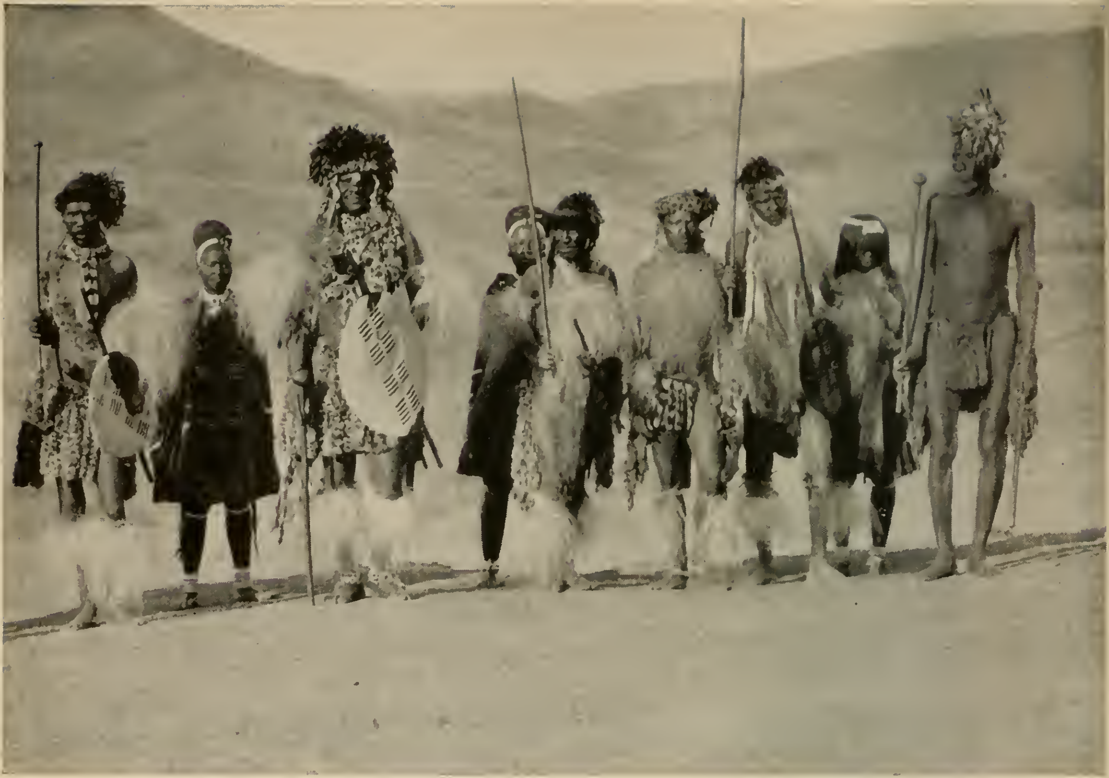
One who has lived with these folk can understand the spell of their spirit world. The semi-tropical sun throws bright highlights and casts deep shadows. The distant vistas are filled with mirages. There is the danger of snakes and lurking beasts, and the spell cast by mystifying nights. The effect of all this is so strong that even the white man may find it difficult at times to keep his balance.

It is a perfect setting for the native with his world of spirits, good and evil—a world largely controlled by hovering ancestors and adverse spirits. The closeness of primitive existence to nature gives a supernatural meaning to almost every detail of life. Any elephant or lion may be an embodied spirit, while the venomous snake is regarded as a reincarnated ancestor, to be worshiped and protected as such. Even the shadows cast at night by trees conjure up to the native mind a world of treacherous spirits seeking to destroy him. Thus his main occupation is the appeasement of his ancestral and other spirits. Disease, misfortune, and death are attributed to them, and to those who invoke such spirits by witchcraft.

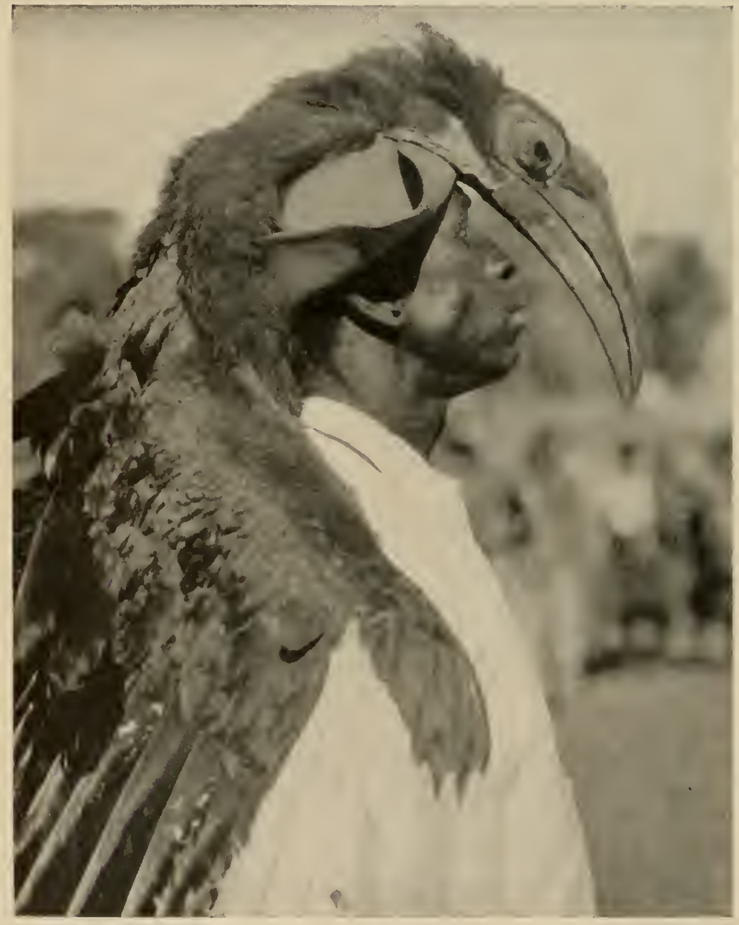
In Zulu the word *Abatakati* means witch, and the word *Ungoma* signifies a witch-doctor, but to the native mind there is a world of difference between them. The witch-doctor functions as a distinguished member of the community, the witch as an outlaw. Both deal in the occult, but the witch invokes evil spirits for his designs, while the witch-doctor drives them away.

The rôle of the witch-doctor is that of guardian against witches and evil spirits. He tells the villagers how to fulfill their destiny, and he cures by driving the malignant spirit out of the sick body. He divines the cause of people's troubles and smells out forbidden deeds. As a dealer in the occult he can bring good or bad luck, or death. From the white man's viewpoint he is also a sinister power who brings about ritual murder, but to the native he remains an oracle whose findings and omens are almost infallible.

The witch invokes adverse spirits and deals in black magic. He deals in things evil, and he casts spells which bring misfortune, disease, and death. A witch will come in handy when a native wants protection or revenge, but he is also a dispenser of charms, and as such carries on a lively, if underhand, trade with the natives. He sells them advice, medicines, and love potions, and tells fortunes. But any dealings with the witch are somewhat risky, since a person otherwise innocent may fall under the spell of the witch and may become suspected of

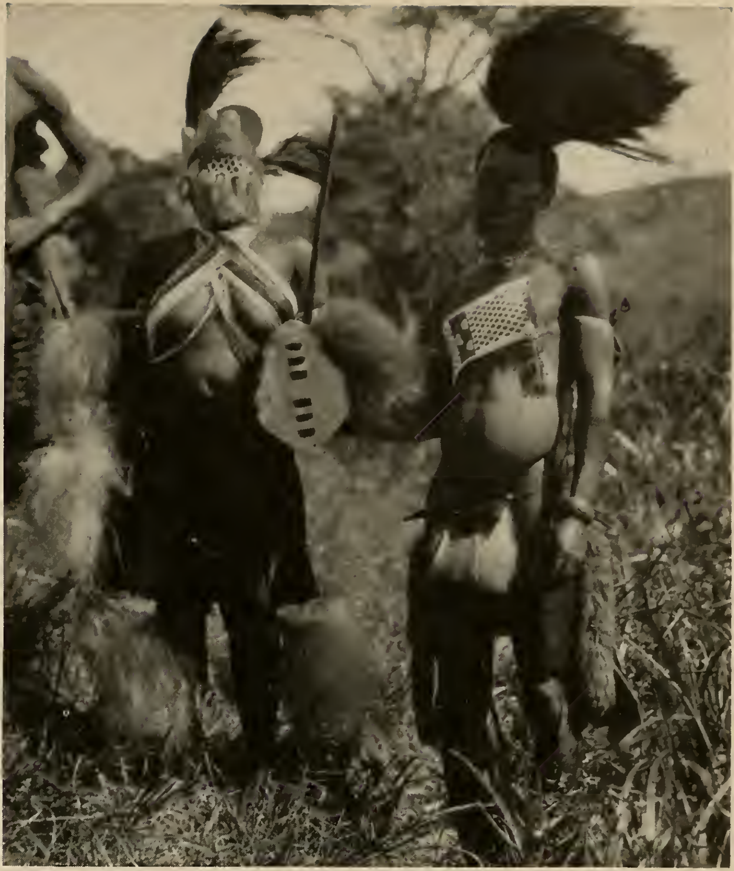


A Zulu chief and his retinue. The fourth figure from the right is the chief's official witch-doctor, while the woman, second from the right, is a witch, influential but nevertheless unofficial except in time of war, when she is called upon to bewitch the enemy

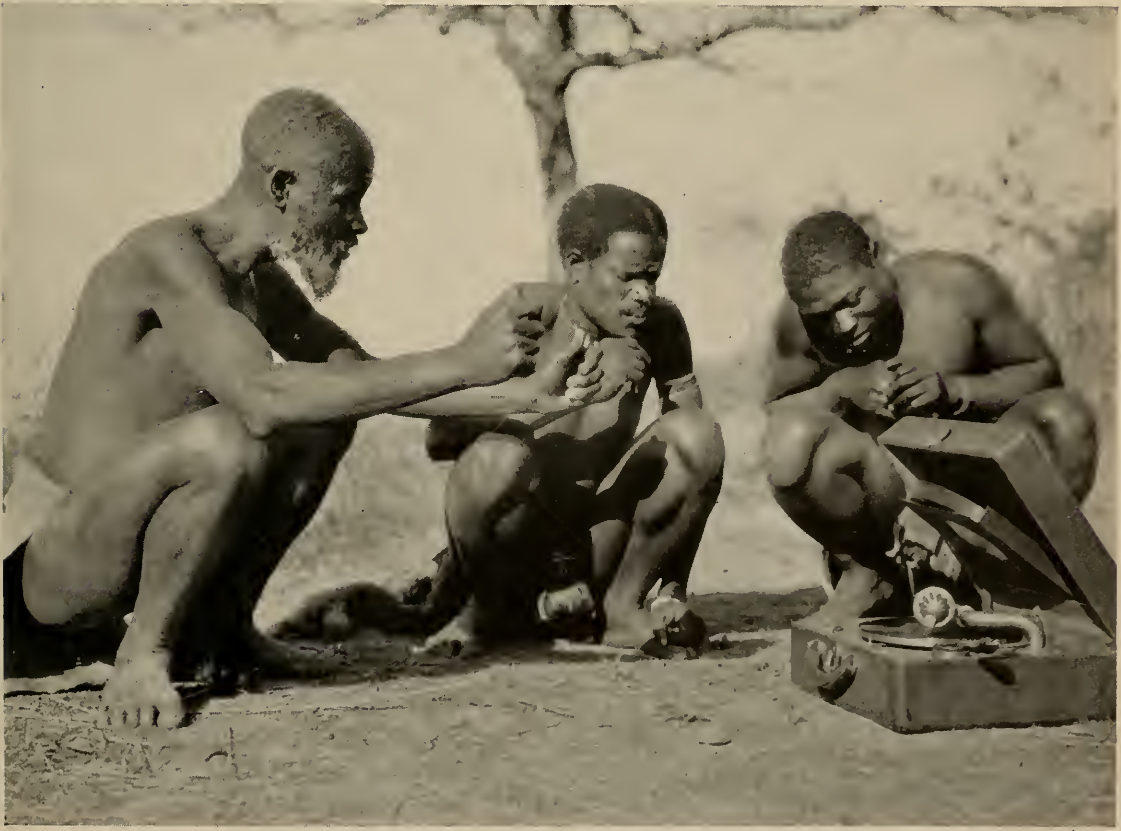


A Zulu wearing the skin of a buzzard, which the wearer believes has certain magic forces that tend to make the owner more influential or distinguished

A Zulu bride with her father. She carries a spear, a dancing shield, and a stick, and is veiled to hide her from adverse spirits. The bladders of sacrificed sheep or goats that she wears in her hair are a sign that sacrifices have been made to her ancestral spirits



A phonograph—white man's "medicine" or magic—contains, so the Zulu believes, the resurrected body of a human being shrunken by magic to miniature size, but still able to speak. The natives are mystified as to what the unfortunate creature feeds on



practicing witchcraft himself. The natives may laugh at the witch when he comes in to the kraal to tell fortunes, but they go in awe and even fear when they seek him out for some hidden purpose. The witch for his part plies his trade under cover of darkness, for detection may mean his end.

Professional and Casual Witches

There are all sorts of witches of both sexes, but practically all fall into two main categories: the professional and the casual. When a Zulu speaks of a witch, he is thinking of a professional witch, of a person who spends his time in black magic and whose services can be had at a price. This person may live openly as a typical native, occupied with the usual daily village routine. There is the usual family life, although in the case of the male witch there may be more wives because he can afford to buy more. Sometimes a reputed witch had to be pointed out to me, since he couldn't be picked out of a crowd, but more often he stood out by his eccentric hair-dress or by the extra number of ornaments tied about his body. Other witches are recluses, living apart from the villagers, often pretending poverty or posing as beggars. The witch belongs to no guild such as that of the witch-doctors, but the craft is usually handed down as a family tradition.

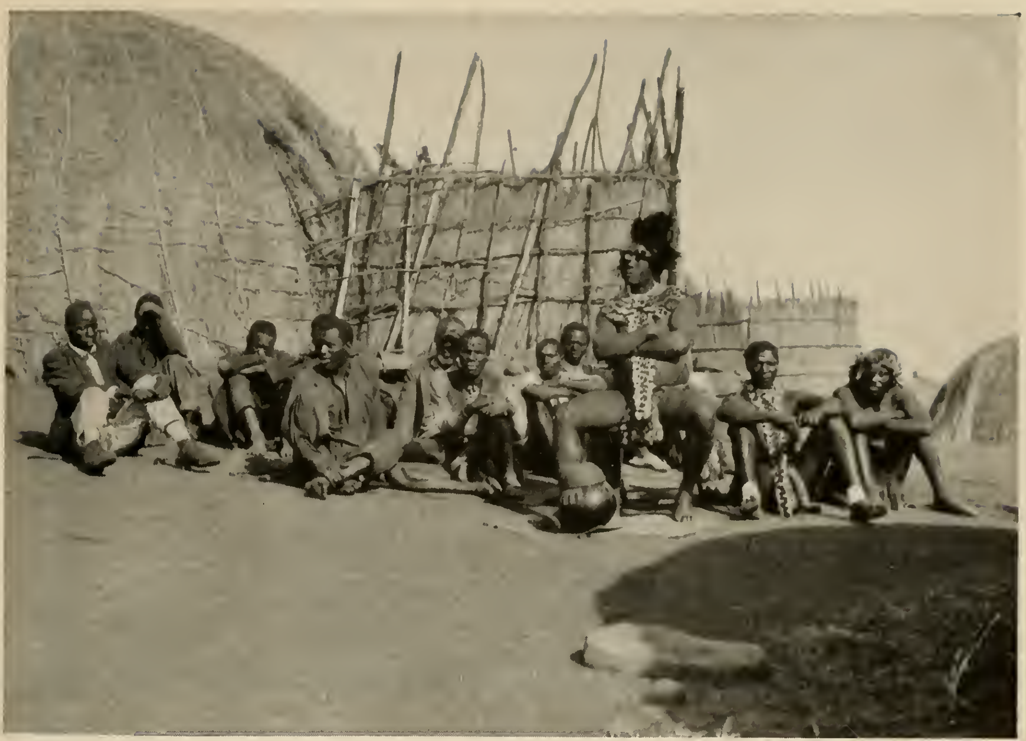
The casual witch is a common event. He may be any person accused through malice or hearsay, or a person who has committed an act of witchcraft for some personal reason. Every Zulu man, woman, or child lives in constant fear of being accused of witchcraft. Anything that deviates from the normal routine of life is attributed to evil spirits or witchcraft, and the native constantly goes about with the words witch and bewitched on his mind, although he is very reluctant to utter the words. But the words come out too often, and tragedy follows.

Typical of what goes on continually is the case of an old woman in the Impangei district. At the white trader's post where I spent the night I heard that the natives up the hill were out in the bush looking for a witch. The next day I got the details. Two old women had been quarreling over some tobacco, and afterward the aggrieved one was heard to mutter something about the other being an old witch. Some time later she took sick with a cold and let it be known she had been bewitched. When asked who had bewitched her, she accused the other woman. The sick woman died, probably of pneumonia, but to the natives all evidence pointed to witchcraft. The accused woman, knowing what was in store for her, cleared out into the bush. Had she remained, she would have been tried before a witch-doctor and probably put to death. That she ran away was sufficient proof to the natives that she was guilty. As for the old woman, death was more or less certain whether at the hands of the natives or by prowling beasts of the bush.

The professional witch operates in devious ways. Much of this is through suggestion, with a great play on local superstitions. If a Zulu, on awakening, finds something smeared on his neck, he knows that a witch has marked him for death. More common is the placing of sticks, fetishes, or medicines in the doorway of a marked man. In such cases fear and brooding by the victim often lead to death. He may run to the witch-doctor, who may help him with potions that ward off the evil influence, or may divine the guilty witch and in that way put a stop to the influence. The fear of being possessed makes the native suspicious of any unusual act.

The White Man's Magic

On one of my early trips to Zululand I entertained a chief with the usual conjuring tricks, and among other things I made a coin disappear and then produced it again from off the bare leg of a native. The effect was quite unexpected. The native was frightened and grave doubts were raised among the rest as to whether he was bewitched and his soul enslaved by an evil force. It took some explanation to reassure them that the white



Wova, a chief of the Zulu tribe, seated in his kraal. The huts are constructed of bent twigs supported by two center poles, and the walls are thatched with grass, bound together with bark

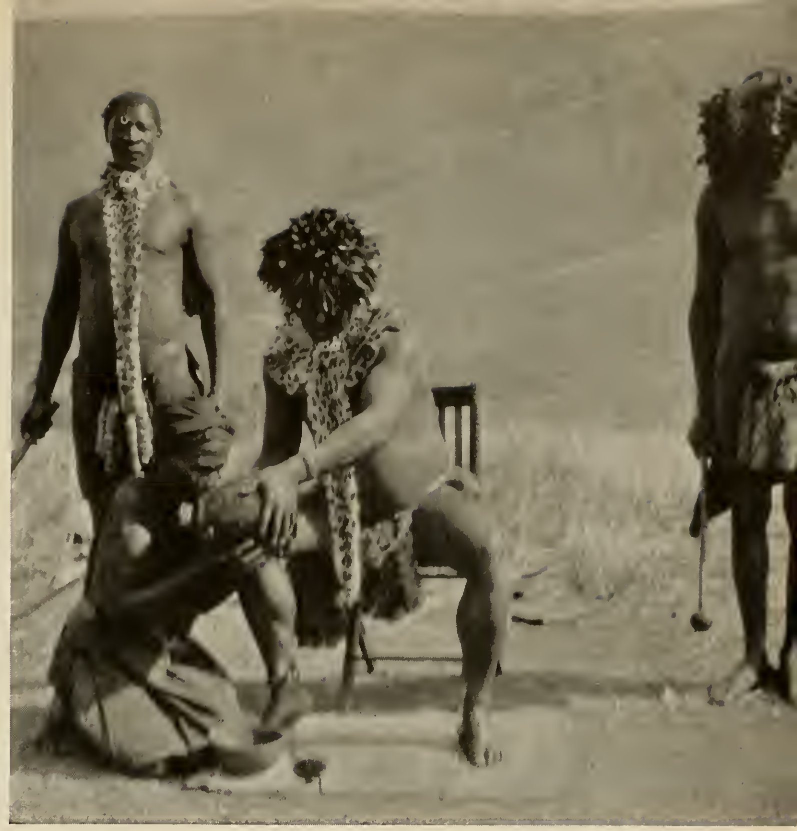
A consultant. This Zulu native, having presented a gift to the witch in whom he has faith, has seated himself in order to await her pleasure before relating his difficulties

A bride (on the right) taking her ritualistic bath before her marriage. The Zulu bride is always purchased for thirteen cattle, and both before and after the ceremony the local witch-doctor is apt to play an important part, his purpose being to drive away adverse spirits or to keep others friendly

Rites and

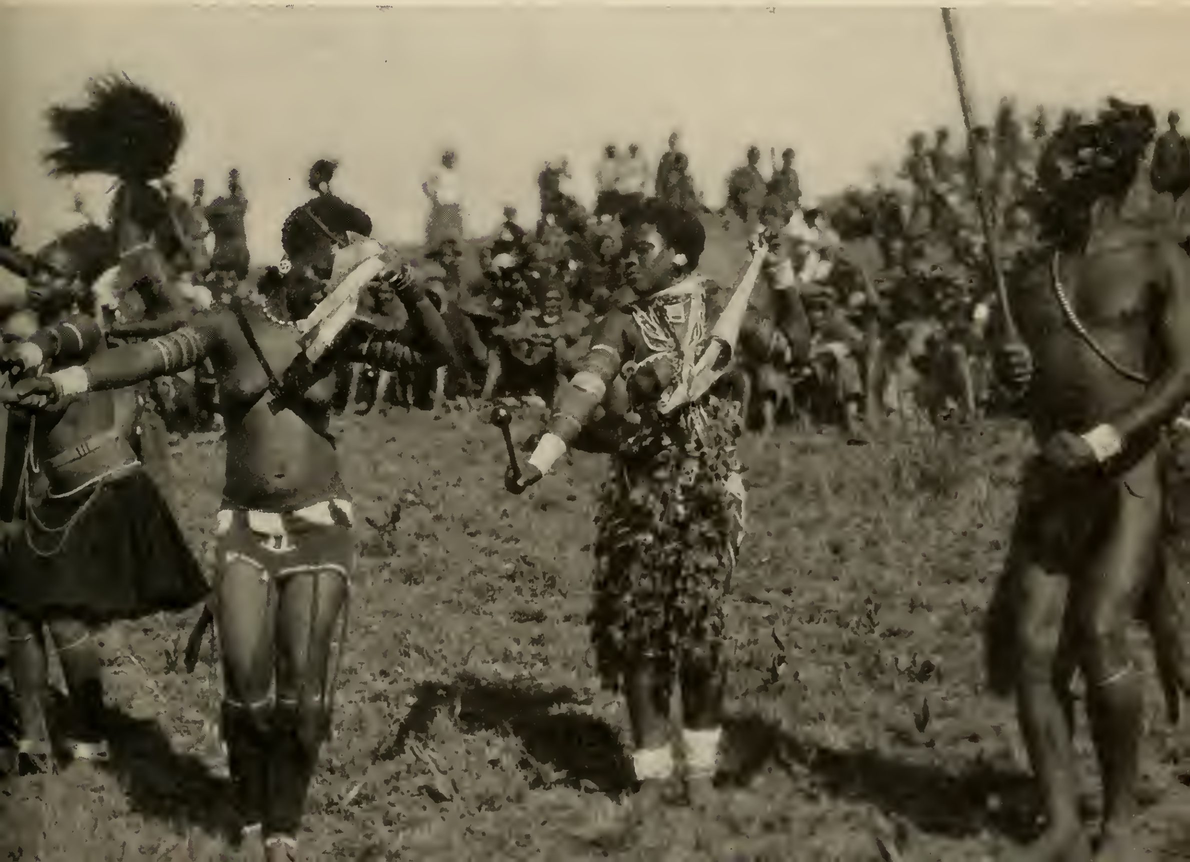
A Zulu chief points with his war club, or knob-kerrie, to the distant hills, where the spirits of the dead "impis" or regiments sway in the moonlight with the cornstalks

Fear is constantly felt that food and drink may have been subjected to witchcraft, or may actually be poisoned. Every chief, therefore, is constantly on the alert for these dangers, and employs an official tester—one of whom is shown drinking from the chief's bowl before the chief himself indulges



Ceremonies

The dancing bridesmaids sweep the air with their brooms, war clubs, and spears in order to drive off any evil spirits that may have designs upon the bride



man's magic could not affect a Zulu. Once assured, the native asked for the coin, since it had come from his leg and therefore must be his.

It is through potions that the professional witch does most of his work. Potions are used for almost everything—to attract, protect, bring luck, and kill. Poisoning is a well-developed art in Zululand as throughout Africa, and the venom comes from herbs, leaves, and snakes. Each witch is supposed to have his own secret formulas. Poisoning is common, but its fatal consequences are invariably attributed to the evil spell invoked by some witch. The fear of the evil spell is especially noticeable at meals. No food is served without assuring the guest that no evil spell or poison has been placed in the food. For the chief there is always the tester who tastes first of everything served. In drinking from the common beer pot, the chief, and each guest in turn, drink only after the tester has taken a few gulps before them. There are also legendary poisons, some of which may produce effects by power of suggestion. A common sight, when a leopard has been shot, is to see the natives pluck out the whiskers of the animal. Leopard whiskers are both feared as an evil potion and treasured as a medicine. When put into food, they are supposed to produce nausea and death, but when mixed with the flesh of the animal, the result is a healthful dish which produces great courage.

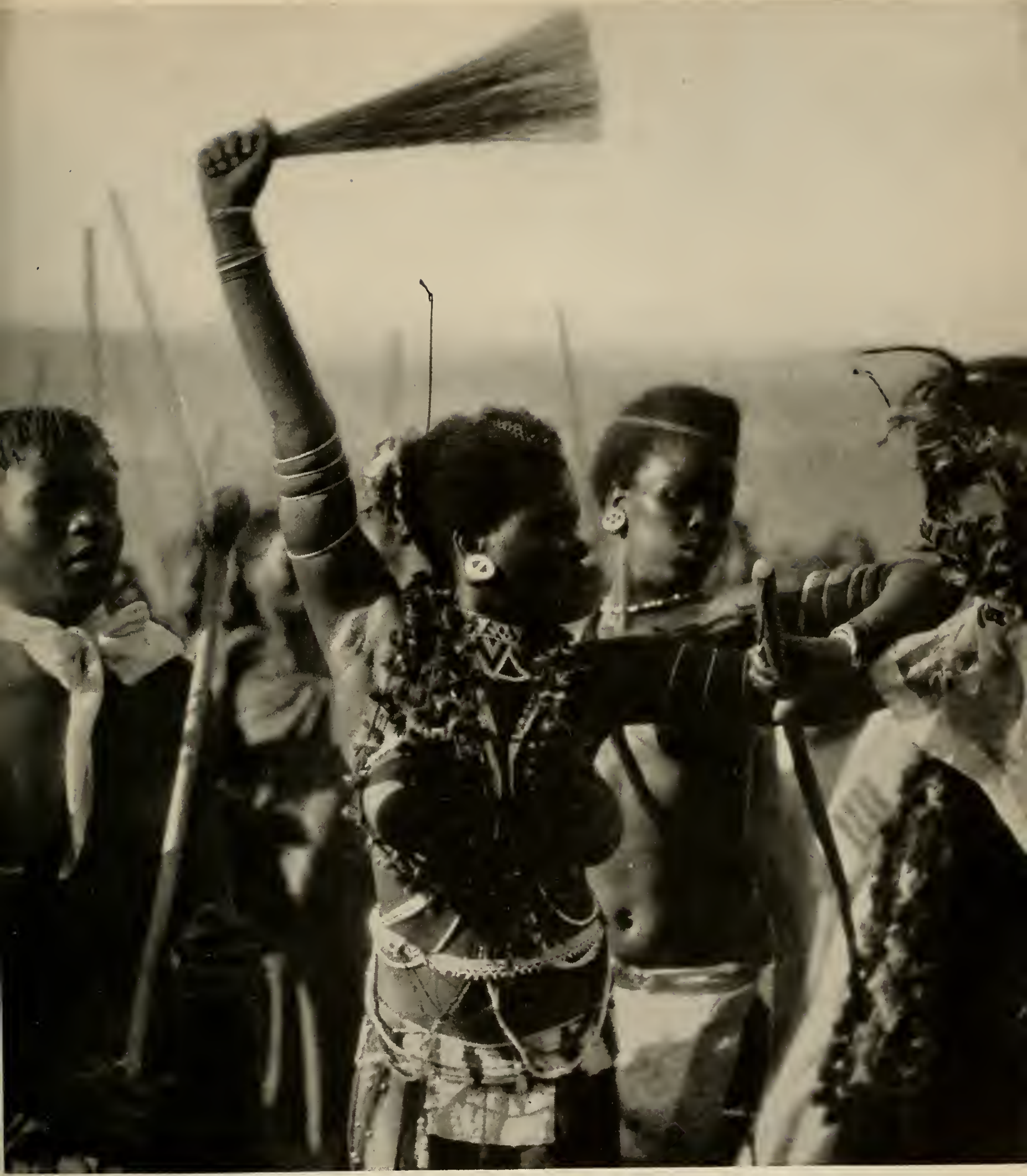
Suspicious Shadows

Tricks and deceptions of various sorts are also resorted to by the professional witch. Ventriloquism is a well-developed art among Zulu witches, and is sometimes worked in conjunction with silhouettes. In one instance I know of, a shadow having the outlines of some wild beast with moving jaws, fell across a kraal, and a voice was heard calling. The natives rushed out of their huts to see a shadow trying to swallow a cow, and heard a voice demanding that the best cow be driven off to a ravine and left there for a hungry spirit. The natives sometimes obey such a voice, but on this occasion, they lit fires and stood guard against the evil spirit. The next morning they called on the witch-doctor that he might divine whether it was an evil spirit or a witch. As usual, the witch-doctor knew that it was not *Amadhlozi*, a spirit, but a witch throwing a silhouette by moonlight, probably from a near-by tree, or that it might even be the shadow of a tree swaying in the wind and made use of by a witch. As usual, he knew who the witch was, but still went through the process of smelling out the guilty one.

The tactics of the professional witch are also attributed at one time or another to the casual witch. A native may have his cow go dry, and having dreamt that a certain person had evil designs on his cattle, he thereupon accuses that person of having bewitched his cow. The accused person may not even deny it, since he may feel he has no control over his soul while asleep, and so lets the witch-doctor divine the "truth," after perhaps presenting him with a goat as a present. If guilty, he may have to replace the cow, and a stigma falls on him which makes his future hazardous.

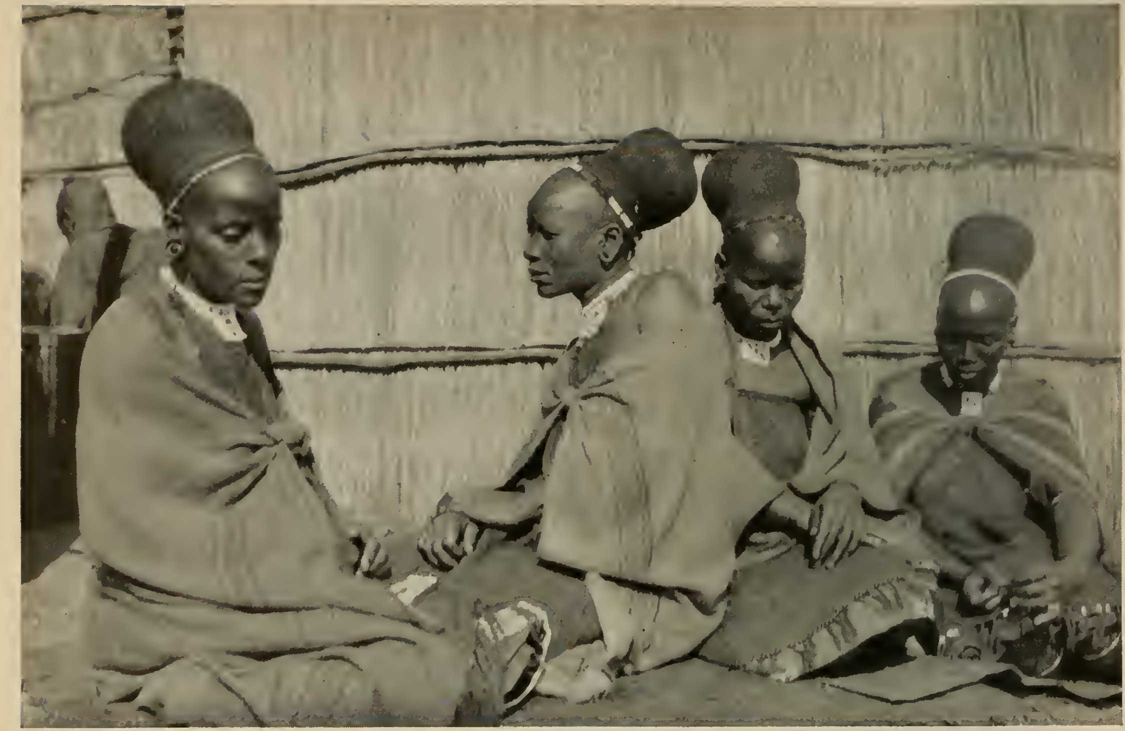
A man may also function as a casual witch if, for instance, he makes use of a love-charm without first making some sacrifice, such as slaughtering a goat for his ancestral spirits. There was the incident of the native who had gone hunting with a love-charm and had managed to bring back a buck. Later, a friend died, and it was rumored that this had been caused by the hunter failing to make the necessary sacrifice.

The casual witch may even be accused of stealing souls and thus be put in the class of a professional witch. The Zulu buries his dead within the kraal, near his huts, for fear that the bodies may be dug up by witches. It is firmly believed that witches resurrect corpses stolen from graves, shrink them into dwarfs, and use them as their agents. The enslaved soul thus becomes an instrument of evil under the command of a witch. On one occasion a hyena was driven off while digging up a fresh grave. No one could con-

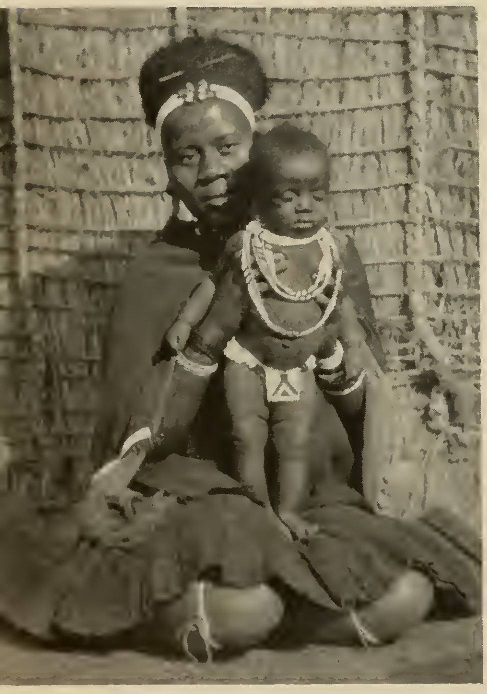


Dispelling The Evil Spirits

The Zulu believes that evil spirits lurk everywhere, but especially where there is an attractive bride. Numerous bridesmaids, therefore, participate in nuptial ceremonies, and it is their duty to protect the bride from these spirits. For two days before the wedding the bridesmaids indulge in a beer feast and compose songs to the groom



Married women. The headdress is woven of their own hair, and is taken down only when they are in mourning for a relative



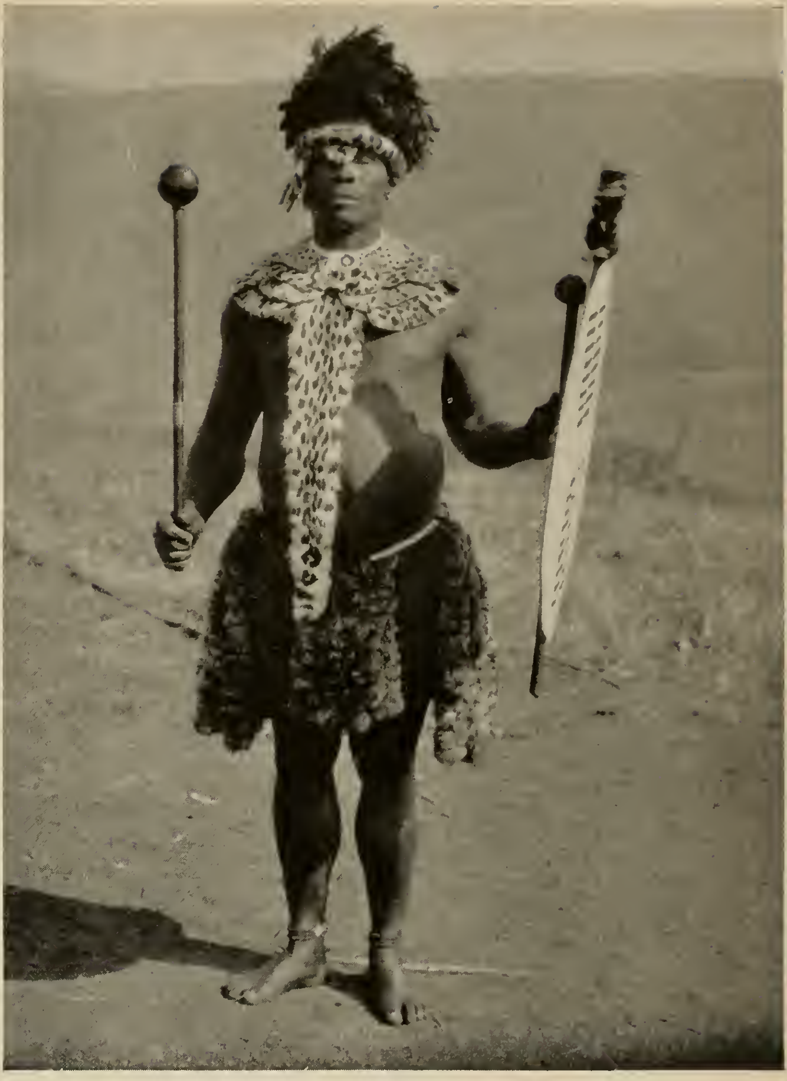
In the Land

A Zulu mother guards her child carefully against any "evil eyes." An admirer, looking at this pretty little girl, will remark "What an ugly boy you have," in order to mislead any adverse spirit that may be lurking about

A Zulu witch, ignorant, no doubt, but nevertheless both influential and awe-inspiring among her people

A Zulu chief in full regalia. The leopard-skin collar and necklace of leopard's claws and teeth, worn only by the chiefs, is supposed to endow them with the ferocity of this beast

of Witches



At the left is a Zulu warrior in full regalia trying to procure a love potion from a witch. Oddly enough, so strong is the native's belief in witchcraft, that such potions often seem to have the desired effect vince the natives that this was not a witch who had taken the form of a hyena seeking to enslave another soul.

Some witches have acquired great reputations and are in demand throughout Zululand. It may even be said that the witch becomes immune to punishment in proportion to his reputation. Eminent witches are called by rival chiefs to throw spells over their enemies, and may even be secretly attached to a chief's staff, although they are outlawed by the white man. The chief himself, however, is careful not to be openly associated with witches, or in any way thought of as practicing witchcraft.

Protection from Blank Cartridges

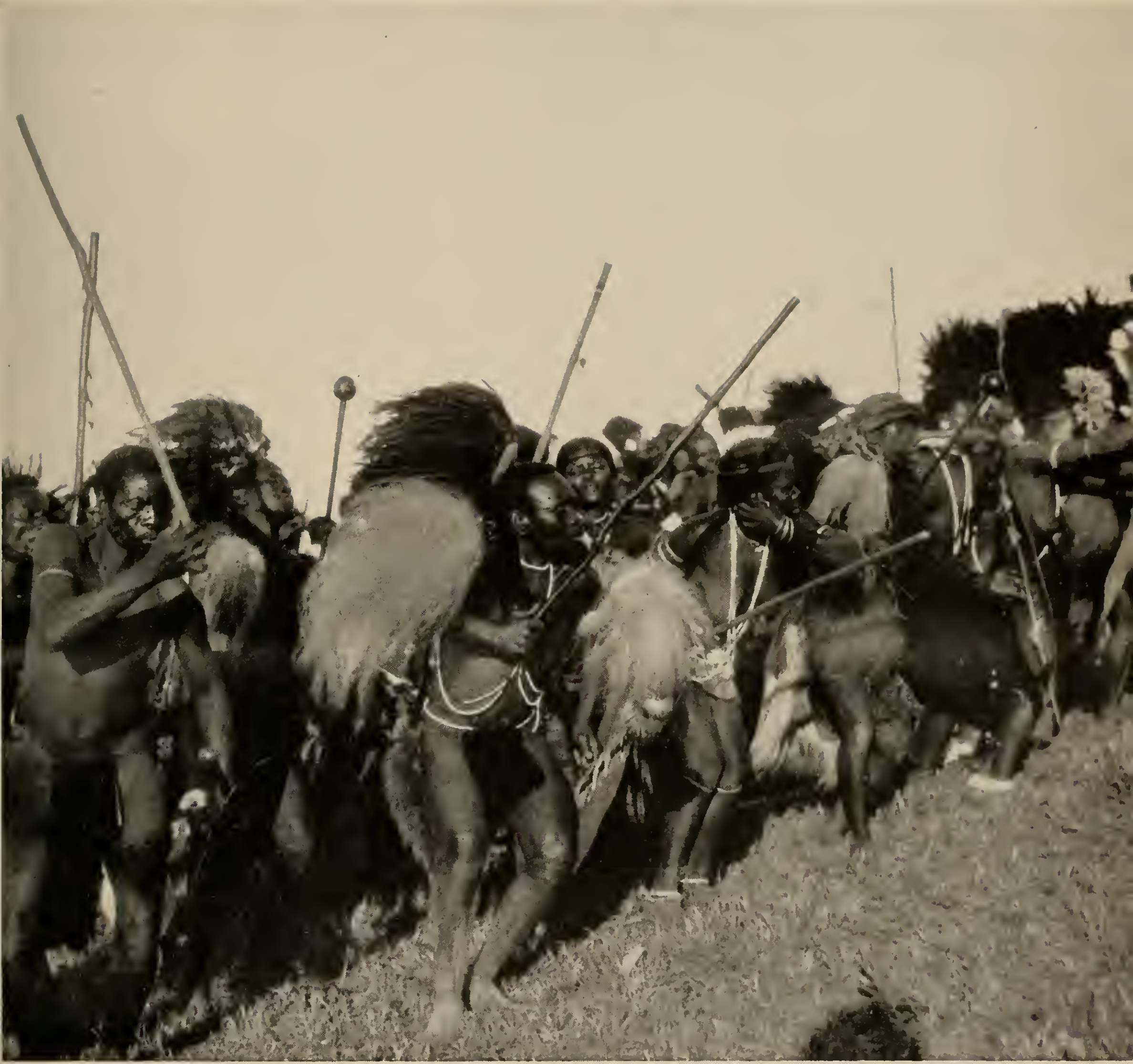
When I was with Selimano Zulu, paramount chief, I entertained him with my usual bag of tricks, including that of the color-changing handkerchief. For the native this meant witchcraft, but I assured the chief it was merely a mechanical trick. On offering it to him as a gift he accepted it but seemed annoyed at not being able to make use of it. He explained that, if he performed the trick before his people, they would suspect him of witchcraft, which was unbecoming a chief, whereas, if he let his people in on the trick, he would lose face for having divulged it. But the average chief will make use of avowed supernatural powers, falling short of witchcraft, to maintain his prestige. I watched a chief demonstrate before his people with a double-barrel shotgun. A native was lined up a few yards distant, and the chief, after placing a charmed necklace around his neck, levelled off and shot point-blank at him. The man walked off, scared out of his wits, but unharmed, and the chief explained that he had protected the fellow from harm, even from the white man's bullets. A sheep was then produced and tied to a stake at about the same distance. When the chief blazed away again the sheep fell dead with a huge wound in its body. The sheep had not been immunized from harm by the chief. The natives, of course, never realized that the shot from the first shell had been removed, but attributed the miracle to the chief's power of protecting his people.

The influence of witchcraft on the native mind, and the rôle played by the witch-doctor, were vividly demonstrated to me when I was staying with the Changane-Zulu tribe in the low veldt along the Sabi River.

At this time I had a native skinner, by name Ngzimba, who was in the habit of disappearing at night although there were no villages near the camp. I soon learned that he was spending the time at the river bank, waiting for elephants to come down to drink in the hope that he could pick up some elephant dung. In moving camp, he piled a bag on to the truck, and since it smelled bad, I asked for an explanation. He then confessed to the elephant dung. Some weeks later he came into camp with a bundle of giraffe ribs under his arm. As the skinner, he was able to collect other bits, such as lion fat, all of which he piled on the truck. It turned out that this was destined for a witch in return for a love potion.

When we made camp at the Sabi River, Ngzimba disappeared for days. We learned that he was courting a girl in a near-by village, the daughter of my native hunter, Bones. This man had refused to let his daughter marry Ngzimba, since the latter could not produce the *Lobola,* that is, the price of thirteen cows, for the girl. Elopement would have meant theft, with the father taking revenge on Ngzimba's relatives while Ngzimba was fleeing Zululand. The alternative was witchcraft, not in a serious way but sufficient to make the girl infatuated with him. When the opportunity offered itself, he made use of his love potion by rubbing it on the girl's arm and then telling her that she was now in his power and that when the moon rose she would be drawn to his kraal or else be made to dash about braying like a zebra.

I learned of this later, after I had seen the father of the girl consulting a witch disguised as a fortune-teller. In a squatting position, constantly clapping his hands, he kept re-



Zulu Warriors

This active group of armed men is engaged in clearing the air of adverse spirits, in order to make a way for a bridal procession. Such protection against dangerous spirits plays a large part in the life of all Zulus peating that his daughter was bewitched, while the witch kept mumbling the name of Ngzimba. When the performance was over, I asked Bones what it meant, and he said that his daughter was bewitched, that she was running about braying like a zebra. Going out of the kraal, we saw a group of native women running after a girl along the edge of a precipice. They fortunately caught her in time, and when we reached the point, I saw that the girl was mad. She was dragged back to the kraal, shrieking and actually braying, and I was told that this had been going on for days.

I heard no more of the matter for some days, but the mysterious silence of the natives, including my own men, made me suspect that something was up. Where before they had laughed about the love potion affair as a good joke, they now merely shrugged their shoulders when asked for news. On my next trip to the village, I finally discovered what was going on. The path crossed a ravine, but on this occasion my men tried to make a detour on the pretext that the stream was no longer fordable. Since it was the dry season, it was obvious that the stream had not risen since I last crossed it. I finally got the real reason out of one of the men. A great witch-doctor had come into the country and was about to drive all evil spirits from the people, and he had chosen that very ravine for the spot where he would drown those evil spirits.

It turned out that the witch-doctor was Lucas M'Zunga, a great Voodoo doctor, a combination of witch and witch-doctor with a smattering of the white man's religion. I approached the place with caution in the hope of watching the performance unobserved. The Voodoo practice, as any witchcraft, was forbidden by the white man's law, and my appearance would probably have disrupted things. But I was soon discovered, and so proceeded to assure the doctor that he need have no fear since I was not a government official. After some hesitation, the man came forward and in Zulu, with a few English words thrown in, said that he was about to drown some spirits. There were three pots near by, with fires beneath, and some of the women were pouring water into them. The Voodoo doctor, dressed in a black robe, stood there holding a Bible in Zulu script, and mumbling incantations. The patients now came forward, stripped to the waist, to be annointed by the Voodoo doctor with lion fat, and among them was the girl who had been bewitched by Ngzimba, muttering to herself but no longer raving. Each of the patients was then told to kneel and drink from the can of water placed before him, while the doctor kept up his incantations. The hot water was served in gallon cans, which formed part of the Voodoo equipment, and the patient was not allowed to stop drinking until the can was emptied as otherwise the magic would lose its force. As soon as one can was emptied by a patient he would be given another, urged on by being told that the more magic he consumed the more certain was the cure. Some were able to finish the second gallon, and all were plainly bloated and apparently in great discomfort.

When all drinking had ceased, the doctor showed them how to insert their fingers in their mouths as far back as possible, with the result that much vomiting started. To those struggling, the doctor shouted that the evil spirit was fighting within them, that it was trying to stay in their stomachs, and must be driven out by throwing it up.

After ridding themselves of the water, the patients got up and walked away with smiling faces, for now they were unwitched. The raving girl was among the cured. When the Voodoo doctor, M'Zunga, left the ravine, his safari contained goats, cows, and sheep that had been paid him for the cure. I later learned from the girl's father that among these were four cows that Ngzimba had owned but which had been seized by the chief's order. Furthermore, Ngzimba had apparently cleared out for good. Had he remained, he would, no doubt, have found his standing in the community very sadly impaired.

Iron

Since primitive man first discovered iron and began to solve the problems its use presented, it has grown in importance until today it forms the basis of one of the world's greatest industries

By

Thomas T. Read

Professor, School of Mines,
Columbia University

Ewing Galloway

IT is an indubitable fact that the metal, iron, which is outstandingly most useful to man, is found in large mineral deposits of high quality, and these are widely distributed over the world. There are, indeed, but few regions that lack deposits of iron ore capable of being worked for the production of the metal, in at least a small way. In some countries, such as Brazil, there is unfortunately no coal near by, but in all the great iron-making countries of the world there are large deposits of iron ore and coal with which to reduce it to usable metal.

These iron ore deposits have always been available during the whole period, 25,000 years or more, in which men have been making use of minerals to maintain and improve their conditions of existence, but it is only quite recently, say in the last 3500 years, that man has been able to make any effective use of them. It is natural to blame that delay on man, and suggest that it was because he was "dumb" that it took him so long to produce iron from the ore that was available to him in such abundance That is an unjust inference, however, and it would be more fair to marvel at the practical skill of the primitive metallurgist who, unable to distinguish between elements and compounds, and with no understanding of the master rôle that carbon plays in the production of iron of usable quality, was yet able, at least as early as 1500 B.C., to produce iron of a quality that was useful to him.

The much debated question as to how early man first produced iron from ore is complicated by the fact that iron occasionally falls on the earth's surface in the form of meteorites, and presumably has been doing so ever since the earth first had a surface. This metal of celestial origin can usually be identified, for it commonly contains from 5 to 25 per cent nickel, whereas the metal man has made from ore practically never contained any nickel until, in recent years, he learned to add it to steel in order to produce increased hardness and toughness. In this way it is known that many races, not only such primitives as the Eskimo but those of a quite advanced culture, such as the Mayas, Incas, and Aztecs

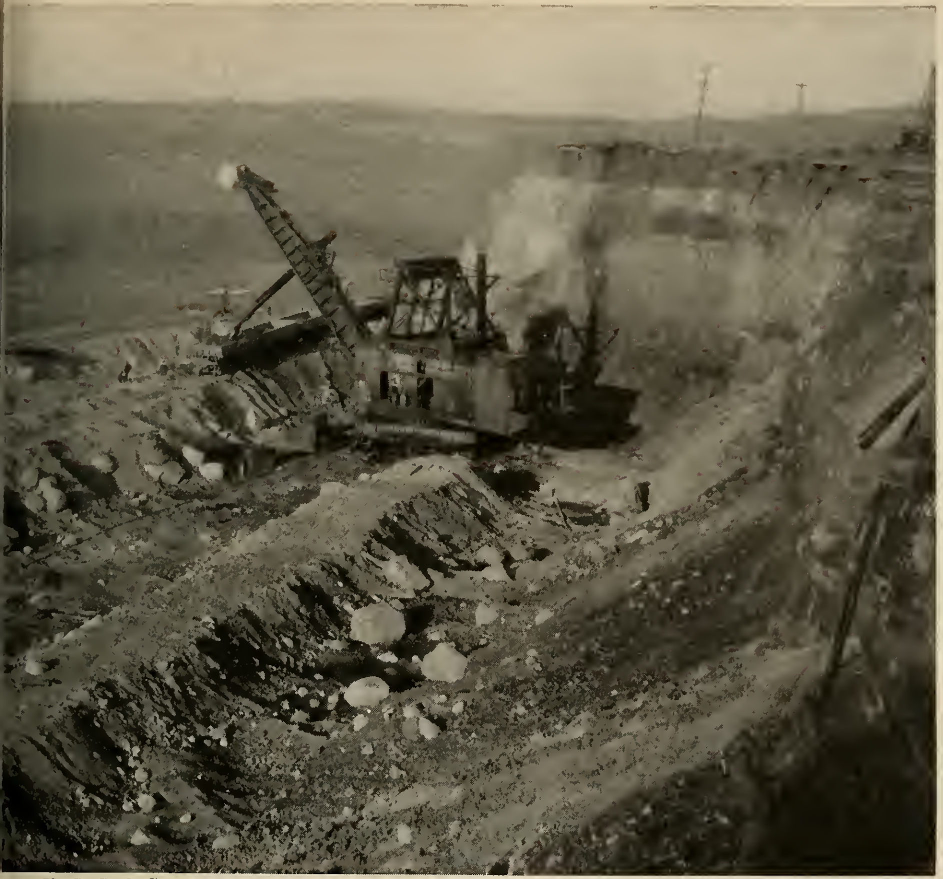
From Mine

Ewing Galloway

"Steaming" freight cars that have been loaded with iron ore in cold weather, at Proctor, Minnesota, to permit the solidified mass to pass through the bottom-dump gates

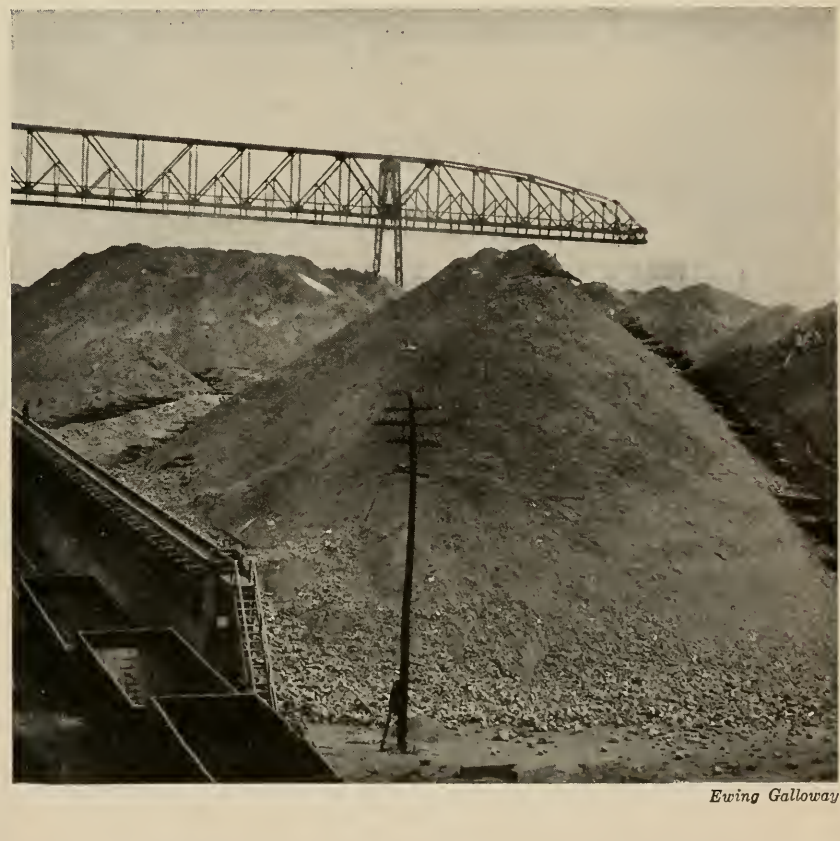
Ships loaded with iron ore at Duluth, Minnesota, play a dominant part in the waterborne traffic of the Great Lakes. The picture on the right shows one of these ore carriers being unloaded at Buffalo, New York

Ewing Galloway



tesy U. S. Steel Corp.

Smelter



The Mesaba Range of Minnesota contains one of the world's greatest deposits of iron ore, a fact that has gone far toward making the United States dominant in the iron industry. The photograph above shows a vast "open pit" mine at Hibbing, Minnesota. At the right, ore from these mines is shown stored at Cleveland, Ohio, prior to smelting

Ewing Galloway

had never learned to produce iron from ore, because the small amount of iron they possessed is indubitably of meteoric origin. But not every museum specimen has been analyzed, and there is also sometimes doubt as to whether ancient iron objects are really as old as the surroundings in which they were found. Consequently the early history of iron is clouded with much uncertainty.

The Natural History of Iron

A fairly certain landmark in the history of iron is a clay-tablet letter written about 1300 B.C. "by one of the Hittite kings saying that he was about to send a shipment of 'pure iron' to Rameses II, who had asked for it, and that meantime a sword of iron was being sent to the Egyptian king as a gift." (*Ancient Times*, p. 244.)

In reaching an understanding of what this letter signifies as to the status of iron-making at that time it is necessary to remind ourselves of the basic elements in the natural history of iron. We have already said that iron ores are widely distributed. Deposits that contain millions of tons are not uncommon and are the ones most talked about, but primitive man was not interested in millions of tons of ore. Even as late as the Eighteenth Century here in America a furnace that used more than a few tons of ore a week was a large one. Small deposits that are now of no commercial interest were then ample and supported an important essential industry. Enough wood to make charcoal for fuel, a little ore, and a local market for the metal was then enough.

The ore, then as now, was always iron oxide, much the same thing as the rust to which iron returns if it is left exposed to the oxidizing effects of air and moisture. The making of metal from it consisted of utilizing the charcoal to rob the iron ore of its oxygen, thus turning it back into metal. It sounds quite simple, and it is for a modern who understands what "carbon monoxide-ferrous oxide equilibrium ratio" means, and how to control it. But for a primitive metallurgist, who was guiltless of any such knowledge, it was extremely difficult.

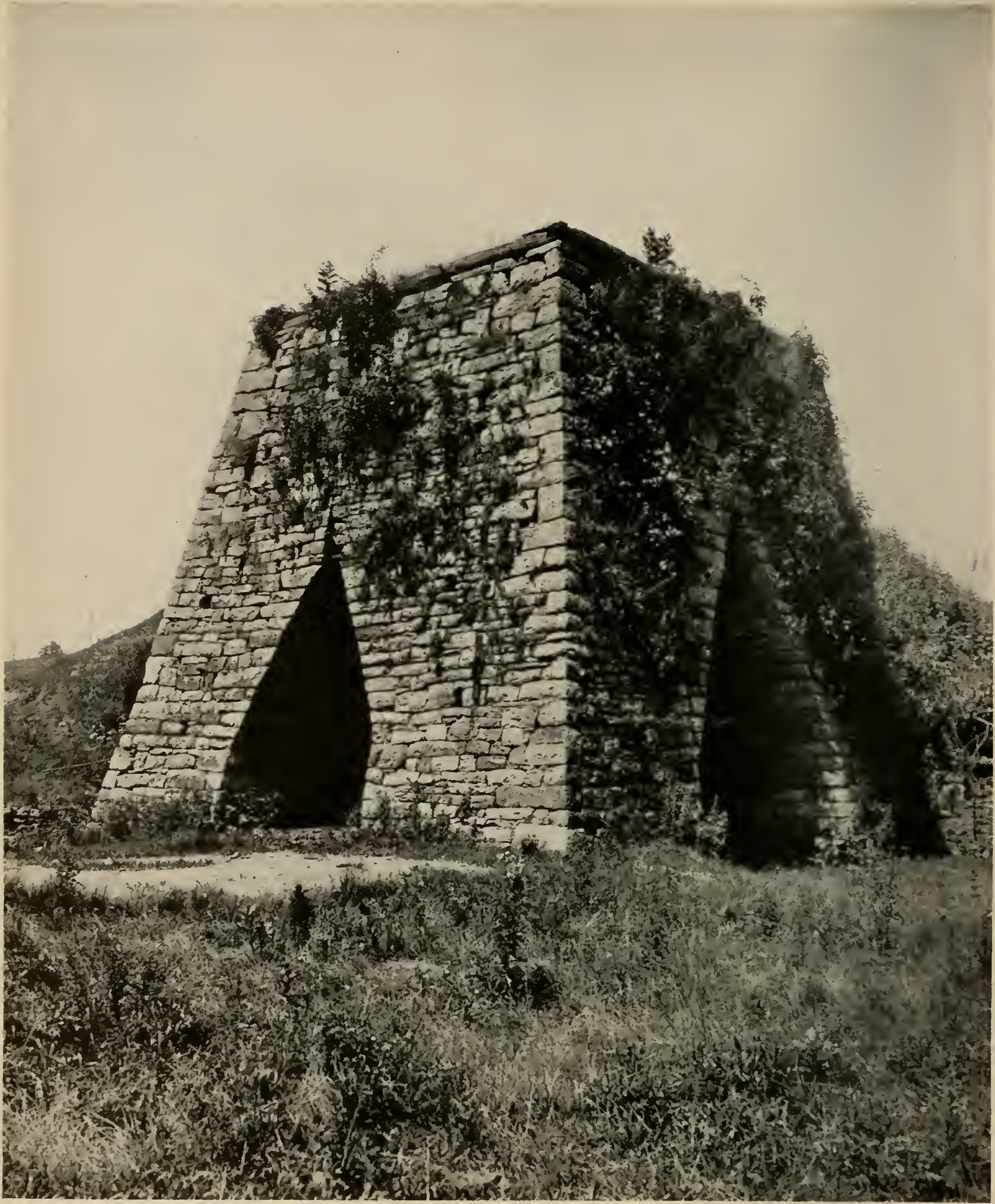
A really preposterous lie often seems to have everlasting life. Herodotus said that men learned how to make iron because the forest on Mount Ida caught fire and reduced the ore to metal. Down to this day many people who should know better make similar and equally preposterous statements about the probable origin of iron smelting. Iron ore cannot be reduced to metal in any such way, because iron happens to hang on to its oxygen with much greater intensity than do lead, tin, and copper. Nearly everybody nowadays knows that when carbon burns, it forms carbon dioxide, but if there is an excess of carbon and too little oxygen, carbon monoxide will be formed. Burning to carbon dioxide yields twice the heat that monoxide does, so it is not merely because the monoxide is poisonous that the normal aim is to burn to the dioxide. Luckily, all you have to do is provide any fuel with plenty of air, and it will burn to the dioxide, yielding all the heat there is in it.

That natural way of burning is no good for the production of iron, however, for the carbon dioxide plays a sort of ring-around-a-rosy with the iron; the iron takes oxygen from it, going back to oxide, and the dioxide is reduced to the monoxide. No metal results from heating iron ore with fuel unless the operation is so managed that there is such an excess of carbon that carbon monoxide is formed in sufficient amount to prevent the dioxide from oxidizing the iron. If that condition is maintained, the heat required to produce iron metal from ore is not very great, only a dull red. Many people erroneously suppose that forced draft is necessary for the reduction of iron, and therefore say that iron could not have been produced before the bellows was invented. But it is perfectly possible to produce metallic iron in a furnace operated by natural draft; the only thing that is not possible is to melt the metal in such a furnace. The primitive metallurgist never melted his iron; he did not need to, for he early found that he could weld small pieces together to make a large

Ewing Galloway

Steel

A steel mill on the Monongahela River, near Pittsburg, where one of the world's greatest centers of the steel industry has developed. Here an endless output of steel, in its infinite variety of shapes and sizes, is forever passing its ordeal by fire, in order to fill the ever increasing needs of the world



Ewing Galloway

Old and New

Erected in 1792, this stone structure formed a part of one of Pennsylvania's early steel mills. In the 142 years since its erection, almost the entire development of America as a producer of steel has taken place

Ewing Galloway

Pouring molten iron from a ladle into a runner which conveys it to moulds

Great ladles on heavy steel trucks constantly carry tons of molten iron to and fro about the huge mills

Ewing Galloway

piece. The lump of metal produced in primitive furnaces was large enough for most of the uses to which iron was early put. It was necessary to work with small pieces, because the metal had scattered through it the non-metallic impurities that had existed in the lump of ore, but, by hammering the lump, most of them could be removed.

Converting Iron Into Steel

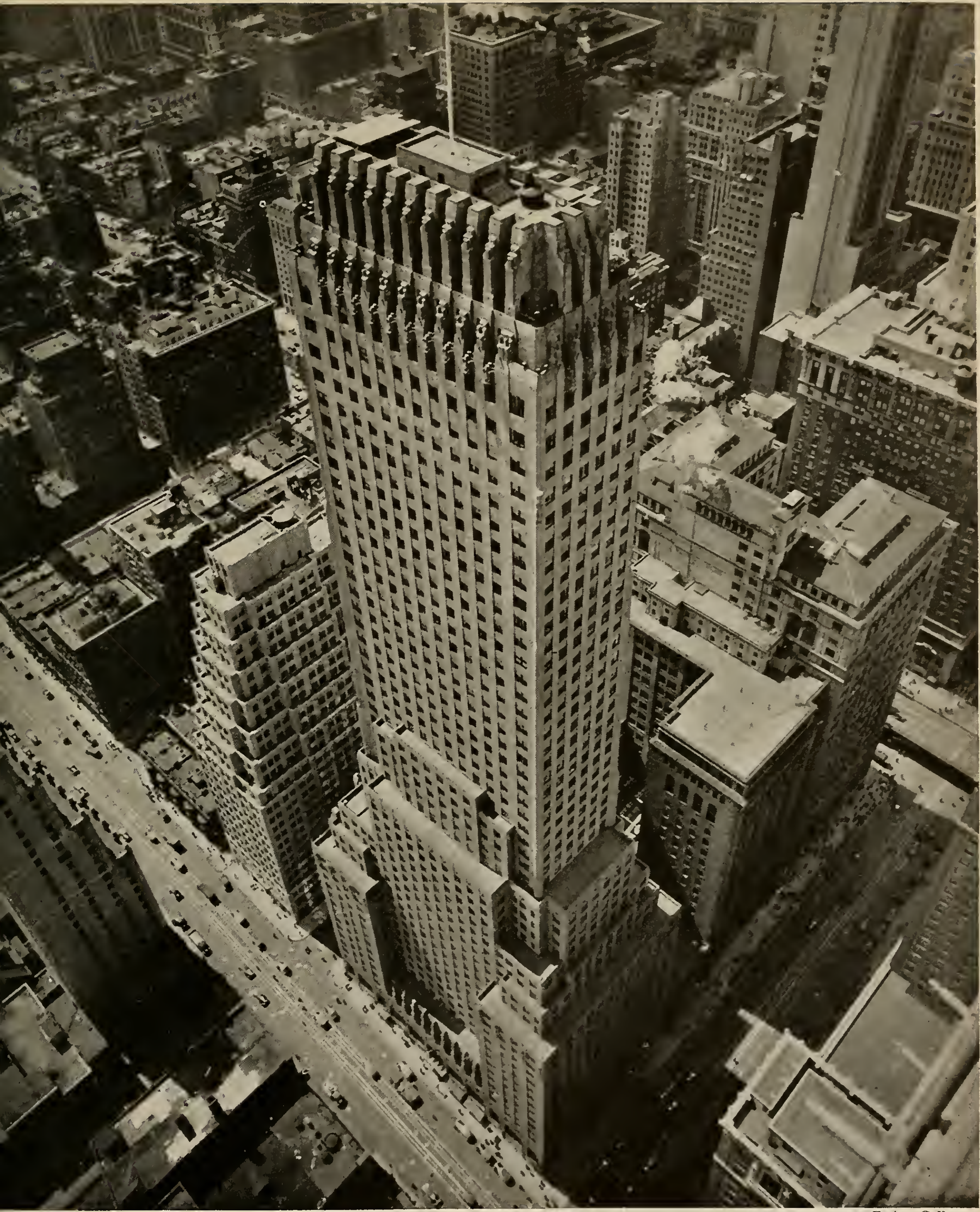
With enough carbon present so that the iron would not oxidize, a tremendously important thing happens. The iron absorbs carbon, not with the avidity that blotting-paper absorbs ink, but effectively enough to produce marked effects. For if the iron has absorbed as much as 8 or 10 pounds of carbon to a ton of metal and a red-hot piece of it is plunged into water, so it cools quickly, it shows a marked increase in hardness. Metal that is naturally too soft to be of much practical use thus becomes the hard material we know under the generic term of steel. Too much carbon makes it too brittle as well as too hard. One can imagine how difficult it was for the early smiths to secure hardness without brittleness when all they knew was by heating and cooling it in the right way (and if the gods were favorable) they got good metal. It requires much skill to get good results even when you understand what you are doing; it is marvelous that anyone could get good results without understanding the rationale of the process. But all the early swords and armor were made by smiths who were guiltless of any knowledge that there was carbon in iron, or that the solid solution it forms at high temperatures has a transformation point, and that by quick chilling the hard material can be prevented from transforming into the soft metal yielded by slow cooling.

Whether it is correct to maintain that the Hittites were the first people to discover how to make iron that could be hardened, and thus utilized for cutting tools, it is impossible to say. One may raise the question as to whether it could be called a discovery, since they did not understand it. Also it seems probable that others had previously been able to make some iron of usable quality, for copper smelters and bronze casters surely would have often tried the experiment of endeavoring to produce something useful from the iron ore that was so much more abundant than the raw materials they worked with. However, the Hittite smiths seem to have been the first to acquire a practical mastery of the control of carbon in iron. What they were all trying to do was rather like shooting at a target. The first attempts mostly missed the target, only an occasional one registered by accident. The Hittite smiths were skillful enough so they could hit the target nearly every time, and now and then they scored a bull's-eye in making an object of steel as good as it can possibly be made. Their expenditure of effort was enormous, and the product was correspondingly expensive, but it was well worth it, for a steel sword or knife took and held a much better edge than a bronze one could.

Chinese Smiths

In China the smiths learned at about that same time how to make the iron take up enough carbon so it could be melted and cast in the way they had been casting in bronze for generations. Before the time of Christ the Chinese used cast iron coins and made many other things of cast iron, but nowhere else in the world was it used much, apparently because it cost too much in proportion to its usefulness. Up to the Middle Ages the Western World used relatively little iron, nearly all of it of the composition we call steel, and employed it for spears, swords, knives, armor, and to a lesser degree for peaceful purposes.

So far usable iron had been made by producing carbon-free metal and causing it to absorb enough carbon so it could be hardened. As furnaces used for the purpose grew larger, temperatures were increased, and the time of the exposure of iron to carbon grew longer, some fused metal was



Ewing Galloway

With Skeletons of Steel

Without its intricate and weight-bearing skeleton of steel, the modern skyscraper would never have developed, for masonry walls thick enough to bear the weight of such structures would seriously cut down the available space within occasionally made, because if iron takes up as much as about 80 pounds of carbon to the ton of metal it melts at a temperature of 1180°C. Metal that is high in carbon is so brittle that it cannot be used for anything but castings, but in steps that cannot now be traced it was, by the Middle Ages, found possible to strip it of some of its carbon and bring it down to a usable content. Finally, in 1784, Cort learned how to produce carbon-free iron from the high-carbon fused metal, and the wrought-iron industry was born. The product made in this way was somewhat different in quality from the small lumps of carbon-free iron made by primitive metallurgists, but the main significance of this development was that it produced carbon-free iron in larger quantities at a lower cost. Wrought iron became abundant and fairly cheap, because mechanical devices for rolling it into bars and strips had simultaneously been invented. This was a landmark in iron's history.

ALLOY STEELS

The next great landmark in the story of iron was Bessemer's discovery that, if air was blown through melted iron containing about 80 pounds of carbon per ton, the carbon could be quickly and cheaply burned off. Steel was thus, for the first time, made in large quantities at a low cost. Later it was found that a slower operation in the open-hearth furnace produced steel of more uniform quality, and the tendency in steel manufacture for the last fifty years has been toward metal of higher and more uniform quality.

This late period has seen the rise of the alloy steels. Careful study of the nature and constitution of steel revealed the effects produced by adding nickel, chromium, manganese, vanadium, molybdenum, and other elements to it. Nickel, for example, makes the steel hard without making it brittle; nickel and chromium together produce a better effect than either used alone. Everyone is now familiar with "stainless" steel, and many realize that it contains 18 per cent chromium and 8 per cent nickel. Properly made and treated, it resists corrosion to an unbelievable degree. Steels can be made to resist specific corrosive agents, and with various physical qualities, such as unusually high permeability for lines of magnetic force, or with low permeability if that is desired. It can be made resistant to corrosion at high heats, resistant to abrasive wear, resistant to shock, or having almost any combination of qualities desired. Just as a cocktail costs more than a glass of beer, these special steels cost much more than common steel; some of them thirty or forty times as much per pound as the "mild steel" so familiar to everyone in the construction of modern office buildings.

It should not be forgotten that just as the essential material in the bewildering variety of cakes and pies to be had in a bake-shop is flour, so the essential constituent in all these steels is iron. Starting with iron ore, coal, and limestone, often transported hundreds of miles to a furnace that can produce a million pounds of a fused iron in a day, steel is made from it and rolled out in usable forms that sell for only a little more than a cent per pound. Most agricultural commodities that are produced mostly by the forces of nature cost several times as much, and our modern iron industry is an outstanding example of how production costs can be lowered by large-scale production.

ADVANCES DURING THE LAST CENTURY

The amazing developments, especially in the past century, in iron production are not simply, or even chiefly, the result of large-scale methods. They are basically the result of painstaking and careful study of the nature and constitution of iron and its alloys, beginning with the iron-carbon alloys and now embracing everything that may be alloyed with iron. From a practical mastery of the effects of carbon on iron, metallurgists have progressed to where they are now able to produce iron of almost any quality, or combination of qualities, that may be desired to give the best results in serving any human purpose.

A Trailside Tenderfoot

The adventures of a cigar-maker amid an unfamiliar world at the Trailside Museum and Nature Trails, on the Hudson River

Photographs by Laurence Critchell, Jr.
(except as noted)

by William H. Carr
Assistant Curator
Department of Education, and
Director, Trailside Museums,
Bear Mountain, N. Y.

WITH deft fingers Hermon had personally manufactured thousands of cigars for a period of twenty-six years before machinery and the depression combined to force him to accept a position with the "C.W.A." He came to us at the Trailside Museums in the capacity of "general helper" during the summer of 1933. We liked him at once, and our first impression has not changed. Although his Russian was far superior to his English, we were soon able to exchange ideas without undue difficulty.

Hermon is a true student of people. His interest in birds and animals, however, has been largely acquired. We will let the reader judge by the following incident whether Hermon could really "see what he was looking at."

When President Roosevelt crossed the near-by Bear Mountain Bridge, our "general helper" momentarily forgot his work in the raccoon cage and, hat in hand, shuffled over to the bridge toll house to see the procession. From an excellent vantage point he gazed earnestly into the Chief Executive's face. When the resplendent automobiles in the President's party had passed, after having paid toll, Hermon turned to his nearest companion and, with great seriousness, remarked,

"It looked just like him!"

After having made this observation, Hermon, slightly mystified at the resulting laugh, returned placidly to his duties.

We had delegated the task of animal care to him because of his gentleness and conscientiousness. At first he had been rather timid about entering the various cages. He preferred to be on the outside, looking in. After repeated assurances and reassurances, however, he ventured over the thresholds and behind the wire.

Hermon's early experiences in the various cages were pure adventures. Each bird and animal was an absolute stranger to him, a stranger to be cultivated with respect and caution. Our tame turkey vulture annoyed him most of all. He did not object to the owls, hawks, raccoons, deer, crows, or other creatures, but the vulture was "different."

"He likes me not!" Hermon complained.

Hermon had been present when the young vulture arrived, hissing and protesting, in a pasteboard box, direct from its rockledge home on Long Mountain.

He shifted excitedly from one foot to the other as the box was untied and the downy bird burst forth.

"It's a eagle?" he asked.

We explained that it was not an eagle.

"I not like eagle," Hermon announced, though he would give no reason for his aversion. Nor did he grow to like the vulture.

"Willie," the staring, yellow-eyed, great horned owl in the next cage, had a far more alarming aspect than the vulture. Regardless of this, Hermon showed no qualms whatsoever upon entering this enclosure. He would go about his cleaning and frequently would talk to the unresponsive bird, perched statue-like upon its perch.

"Aren't his eyes beautiful?" we would ask.

"Yeah!" said Hermon.

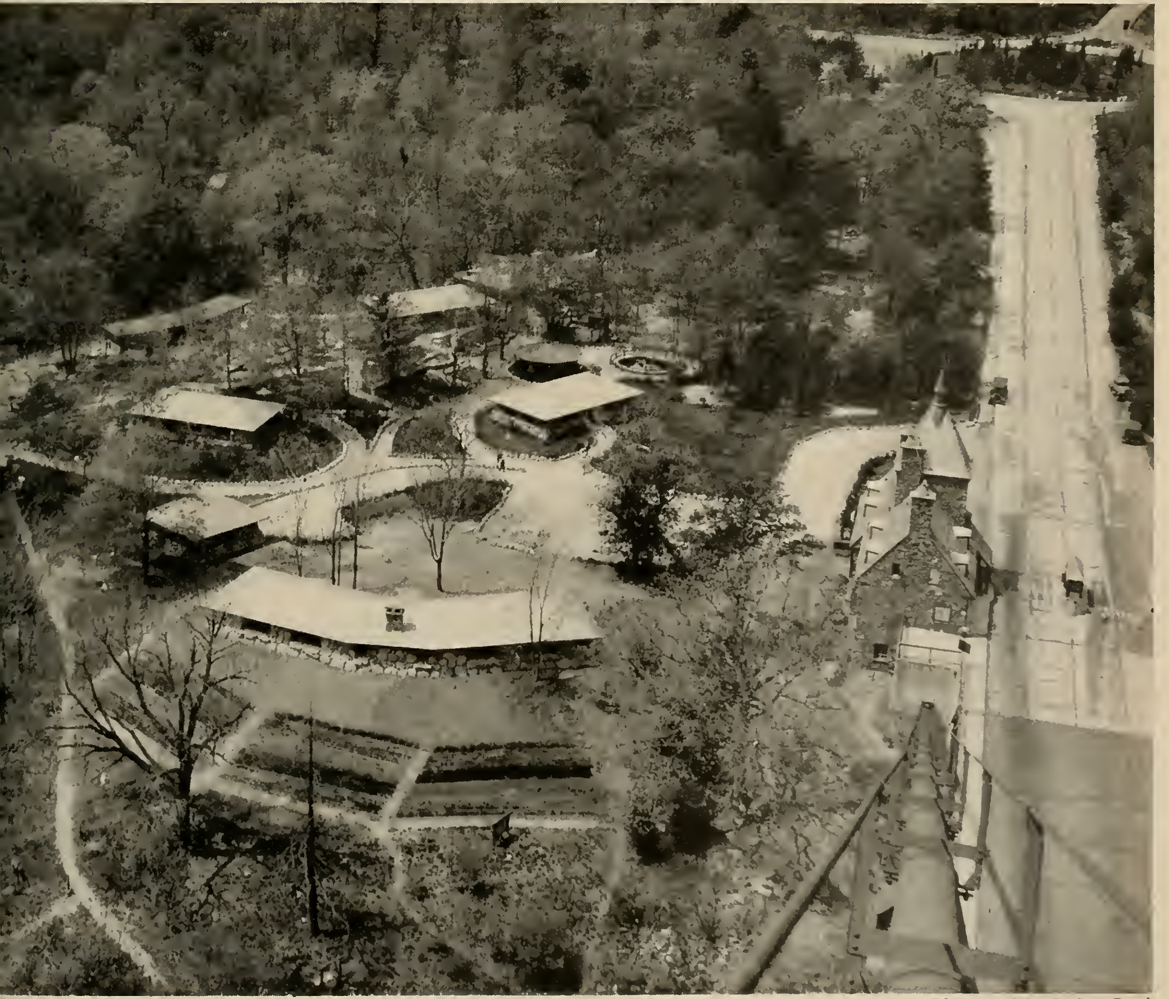
He admitted that he had been alarmed about the owl at first.

At Bear Mountain

Fifty-seven acres of the Bear Mountain Harriman Section of the Palisades Interstate Park have been set aside for the American Museum's Nature Trails. Eight buildings have been erected to house the exhibits and the staff, and at this point on the Hudson River, forty-five miles north of New York City, the country's leading Trailside Museums have been developed. The above photograph shows the Trailside Geological Museum, while the picture below was taken in front of the Trailside Botanical Museum

Visitors examining the moss and lichen gardens installed near the Trailside Botanical Museum

The photograph below shows the main automobile entrance to the Trailside area as it appears from the top of the western tower of the great Bear Mountain suspension bridge



Photograph by Le Roy Davie

"I not know," he said, "I think he might be dangerous, but I see now, no!"

By way of explaining his dislike for the vulture, he would remark, "The people not like him, too!"

In this Hermon was correct. The vulture's naked head, moist beak, and small eyes, combined with its stoop-shouldered, lurching walk, inspired anything but admiration. The fine plumage and remarkable development of the feet, head, and wings seemed to attract little attention.

The Vulture's "Child"

We often pointed out the large, adult, wild vultures soaring masterfully overhead. Hermon found it difficult to believe that these graceful birds, seen high above, could bear any relationship whatsoever to his particular charge. Despite Hermon's antipathy toward the vulture, he nevertheless was much amused when, one day, a visitor, on observing the larger bird's cagemate, a sparrow hawk, offered the opinion that the hawk was the vulture's child!

"No, no," laughed Hermon, "He's different kind altogether!"

One characteristic of Hermon's annoyed us at times, and that was his extreme reticence. He seldom spoke unless spoken to, rarely expressed an opinion, and sometimes kept to himself information that would have been highly useful to us. A good illustration of this latter trait concerned the case of the opossum and the mice.

A miniature "apartment house" had been built to house some white-footed mice and a young opossum. The smaller animals occupied the top floor. While its own cage was being cleaned, the opossum was usually placed for a moment in the mouse compartment.

One winter day the process was repeated just at noon time and the cleaner decided to complete the task after lunch. Consequently the opossum was left to its own devices in its neighbors' house for some forty minutes. Hermon sat in full view of the cage while drinking his coffee and munching his sandwiches.

On returning from lunch the cleaner finished his work and returned the opossum to its ground floor quarters. He placed a full ration of food in the mouse house and closed the door. On the following morning the mouse food remained untouched. Before investigating further as to the cause of this strange behavior on the part of the mice, we interrogated Hermon.

"What's happened to the mice, Hermon?"

The answer was very direct and enlightening.

"The 'possum he eat 'em!"

"What! You sat there yesterday and watched the 'possum eat the mice! Didn't you do anything to stop it? Why didn't you tell us, anyway!"

Hermon shrugged his shoulders.

"Well," he said, "You give mice to snakes!"

That evening the live traps were placed in the woods, baited for mice, and thereafter the opossum rested in an egg crate whenever its residence was being cleaned.

Hermon walked the length of our Nature Trails each day, to and from work. He had no other choice than to pass many labels upon the trees and flowers along the way. He often stopped to read the signs, though we never had any proof that the information became implanted in his mind. In fact, about the only botanical reference he ever made had to do with an experience of his in the World War.

It seems that he had been marching along a road near the front line trenches when, suddenly, the enemy burst out with a murderous machine gun fire that killed 118 of his companions.

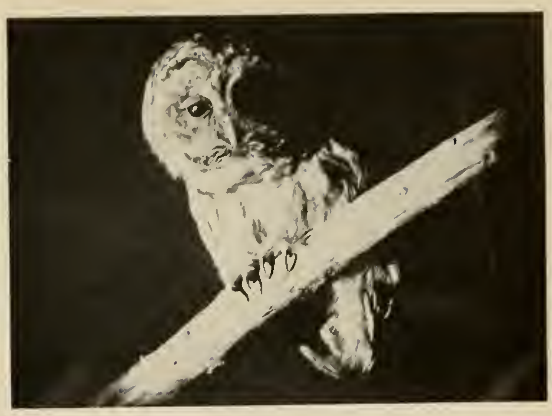
"They were behind trees hidden!" related Hermon, "Always I look at trees after that!"

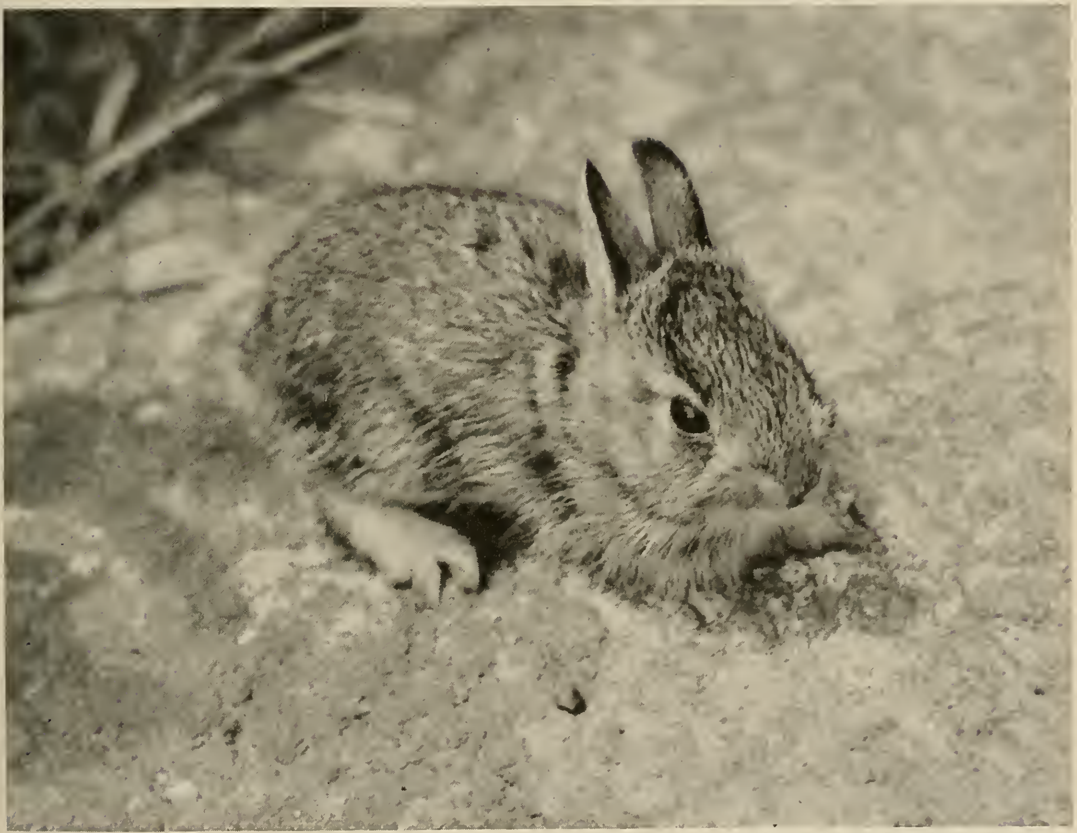
This was a sad background for nature trail appreciation.

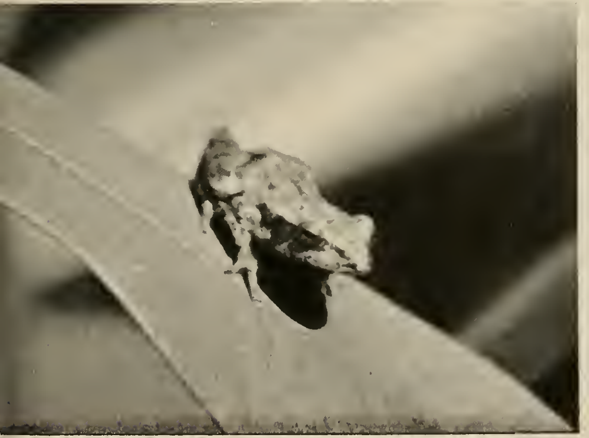
As months went by, Hermon "grew" upon us. We realized that he was in a different world on the Bear Mountain Nature Trails. Sitting in a dusty room, fashioning tobacco leaves, had not prepared him for a life in the open. He still carried an umbrella

Creatures of the Trail

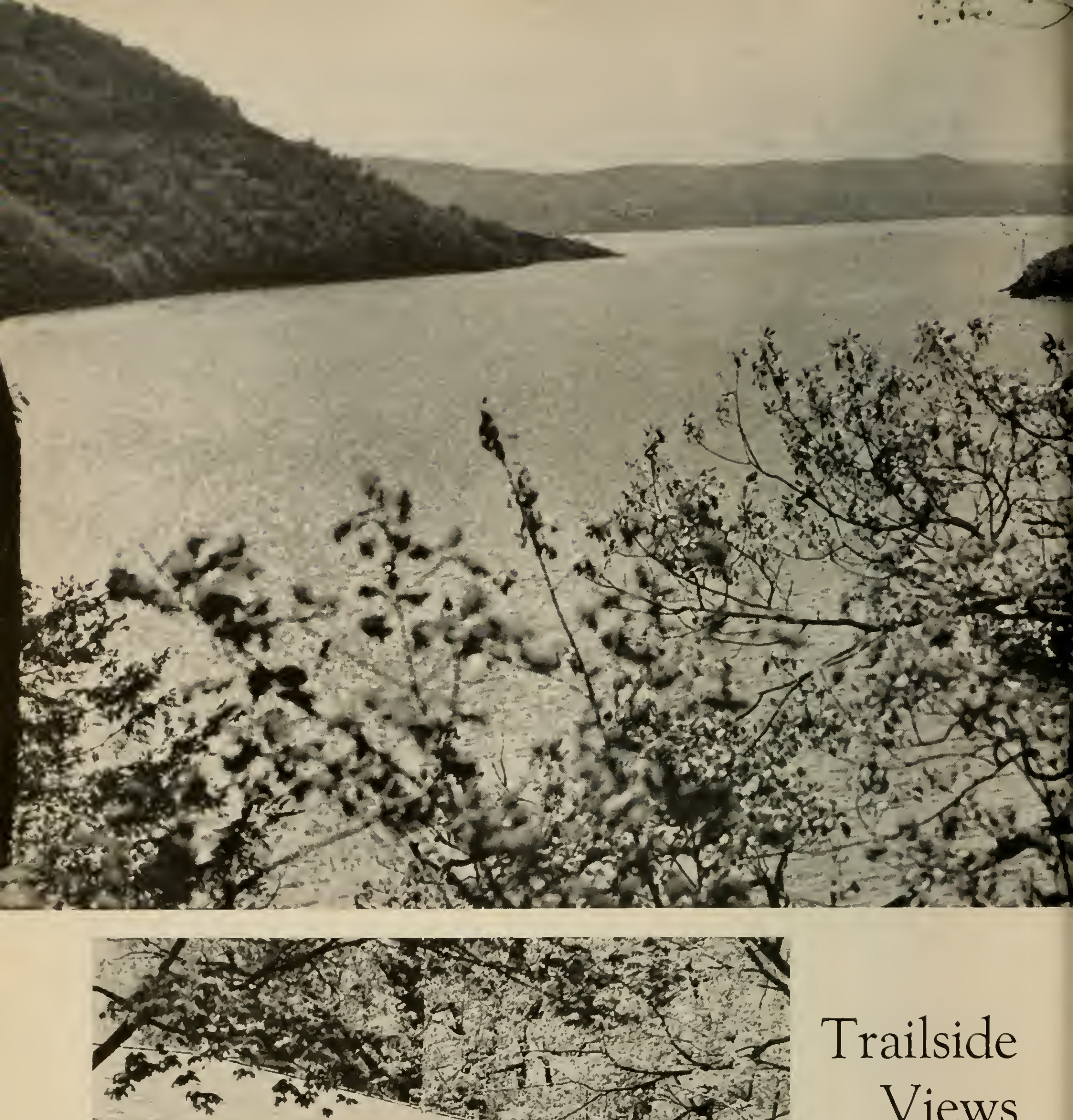
The inhabitants of the Trailside Zoo are entirely natural to the vicinity, and many visitors are surprised at the wide range of local fauna





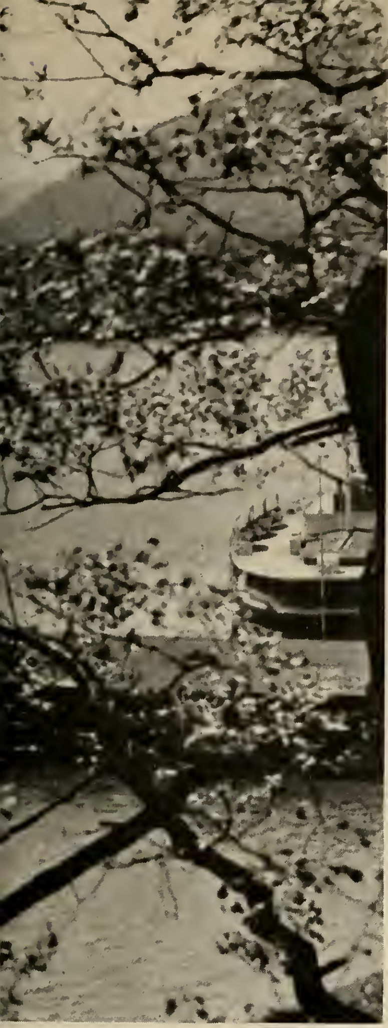


The Trailside's barred owl was photographed by means of light reflected from a mirror. The baby cottontail rabbit was always an easy subject for the visiting photographer, while the spring peeper shown on the rhododendron leaf at the left was far less obvious to the eye than to the ear



Trailside Views

Situated directly across the Hudson River from the mountain known as "Anthony's Nose," the Nature Trails lie at one of the narrowest places in the Hudson between New York and Albany. The picture above, taken from Geology Point, shows Peekskill faintly in the distance. The photograph at the left is of the Trailside Craftshop



Throughout the Nature Trails, trees, flowers, and rocks are carefully labeled for the information of the visitor

The snake pit which lies just beyond the wooden rail shown in the picture below probably attracts more attention than any other one exhibit

through the woods whenever it rained. He was the only C.W.A. man to do this.

When snow and ice covered the ground, he was extremely cautious. When walking upon an icy, slippery surface, he would grasp any object whatsoever to support himself, feeling his way along as though he were blind, while his companions strode on ahead. On one occasion, when passing the staff cabin in mid-winter, he grasped a long, slender, hanging icicle, for support. When it snapped off in his hand and he sat down unceremoniously in the snow, an expression of surprise and wonder crossed his face, as though an iron bar had given way.

The Friendly Raccoons

For a time Hermon lived in fear lest the raccoons escape when he opened the door of their cage. At first he would ask someone of us to accompany him to the cage door to prevent any obstreperous action on the coons' part. Once safely inside the cage, he would carefully clean the watering trough and sweep the floor. When the raccoons approached him, he would talk to them softly, and smile.

Occasionally the friendly and playful coons would grasp Hermon's leg. This made him nervous at first, but eventually he became accustomed to the procedure and would glance at visitors with a pleased expression as though to say,

"See! they like me and I'm not afraid!"

Sometimes the acquisitive animals would search in their keeper's clothing for food. A long, slender, clever forepaw would suddenly reach into Hermon's coat pocket, much to his alarm. This last familiarity was always rather startling to him and he would invariably retire, slowly but firmly, until the offending coon became discouraged and desisted.

In the course of various journeys about the Trailside grounds, Hermon would approach the out-of-door, circular pit, where many large, local snakes were exhibited. These creatures fascinated him. He would stare at them for many minutes until the rake in his hand reminded him that there were gravel paths to be cared for.

During the spring, we kept in a single cage, a Virginia deer fawn, a partridge, and a cottontail rabbit. Often we would discover the partridge sound asleep between the reclining deer's outstretched legs, with the rabbit snoozing near by. This companionship among the animals pleased Hermon. When the three creatures were sleeping together, he would enter the cage very cautiously and go about his duties as quietly as possible lest they be disturbed.

Invariably, a movement of his broom would awaken first the partridge, then the deer, and lastly the rabbit. The partridge, with a preliminary flourish of feathers, would bustle off beneath the shelter platform. The cottontail would scamper away, and the deer would come to its feet and regard Hermon inquiringly.

Although this process was repeated day after day for many weeks, Hermon still persisted in his kind attempts to step softly until the animals had actually moved, then he would proceed, more energetically, to complete his work.

On one occasion Hermon entered the deer pen as usual. The rabbit at once bounded away, the deer arose from its nap, but the partridge did not stir. Hermon regarded the phenomenon with startled eyes. He propped the broom in one corner of the cage and anxiously approached the bird. Still it did not move. Finally Hermon stood directly beside it. Then he knew that the partridge would never bustle off again. Hermon came to us at once with the information. We explained that the bird had been brought to us earlier in the year, wounded with shot, and that its wing had been broken. We expressed sorrow that, after all these weeks of care, the bird had finally succumbed.

Hermon listened attentively and then shrugged his shoulders and said sadly that "the first shall always be last." We asked him what he meant by this sage remark.

"Well," said he, "the partridge, he always get up first, now he's last for good!"

The pilot black snake at the right was photographed in the Trailside snake pit in which, with his sinuous cousins, he lived during the season of 1934

Snakes and Frogs

Hessian Lake, which adjoins the Trailside area on the west, is the source of more than a few of the museum's lively exhibits. The bullfrog below, and others of his kind are natives of this body of water

Hermon was truly something of a philosopher. He did not quote very often, but when he did, it was usually worth listening to! Rarely he invented phrases of his own.

Once, when looking for Hermon, we stepped from the workshop door and called to him loudly. To our surprise he appeared from behind a small tree near by. He was almost within whispering distance, yet we had not seen him, so well had he been concealed by the foliage.

He walked up with a smile, looked back at the tree, and said,

"Few leaves hide man!"

This seemed so much like a quotation from "Charlie Chan," or from his prototype, a Chinese Philosopher, that we asked Hermon where he had read the saying.

"No read," said he, "but true, no?"

We agreed that it was perfectly true.

These rare and revealing lapses of Hermon's would always serve to encourage us to question him in regard to his opinions about things in general, and his present employment in particular. Seldom were we successful in eliciting any satisfactory response. He once admitted that he was still thoroughly at sea in regard to any applied natural history knowledge. He confided that, though he was definitely interested, birds and animals were still just animals and birds to him.

"Fish, now maybe, that's some different!"

He said that he had frequently gone to the Hudson River, and to the ocean beaches on fishing excursions, and that he liked to name and to know the fish that accepted his bait.

Perhaps it was his "fish interest" that accounted for the extra polish he gave to the glass of our aquariums when they were transferred from the Trailside Museum to the Crafthouse winter quarters.

While Hermon could not express himself clearly in English, whether the subject happened to be fish, bird, or beast, it was our own limitation rather than his, that prevented our being able to converse clearly together. He could speak German and Hebrew, in addition to Russian. We are certain that our Russian dialect would have been far more amusing to him, than his English accent was to us. And, while we are discussing comparisons, it might be well to say that we would have difficulty in rolling cigarettes, to say nothing of the appalling prospect of making cigars for a space of twenty-six years! Considering Hermon's background, we are certain that his ability to adapt himself to a totally new vocation would be far superior to ours if conditions were reversed.

The calls of birds were very pleasing to Hermon. As though to chide us for any real or supposed thought that our knowledge of the out-of-doors was superior to his, he once shyly told us, though in different phrasing, that an appreciation of the beauty of bird song was by no means dependent upon language nor upon ornithological understanding.

Hermon was a lover of music in no uncertain terms. We learned that he possessed a complete collection of the Italian, German, and American phonographic recordings of Caruso. He also owned many recordings of famous symphonic and concert orchestras. The only one of our "staff" who could discuss music with him, on his own level, was an Italian cabinet maker, also a "C.W.A." employee. This despite the fact that several members of our group were by no means unaccomplished in musical performance.

"I like good music," Hermon said, "but jazz, No!"

In "better days" he was a frequenter of the Metropolitan Opera House and of Carnegie Hall.

"Some day, again, maybe I shall go," he would say.

Thus Hermon was marking time, as so many of his compatriots were doing throughout the land. With him, this was but an interlude among the birds, animals, and plants. When, and if, the better days come to him, he will return, perhaps to his cigars, and perhaps not. Whatever may occur, there is one thing of which we are perfectly certain, we shall miss Hermon more than he will know!

Nebraska—Fifteen Million Years Ago

Ages ago the grassy plains of what is now Nebraska were inhabited by animals long since extinct. In the following article they are brought to life as a result of scientific study and a scientist's imagination

by
Edwin H. Colbert
Assistant Curator, Fossil Vertebrates
American Museum
Illustrations by Margaret M. Colbert

IT was a hot day out on the high plains, and the sun like a ball of fire that seemed to fill the cloudless sky, made the whole world brilliant and white under its blinding glare. Waves of heated air, rushing up from the dry prairie, caused the distant buttes to shimmer in the midsummer noon. A palæontologist, tired and cramped from his morning of hard digging in the fossil quarry, climbed up out of the excavation to the top of the hill, where perchance he might enjoy any breezes that would be blowing across the western plains.

He reached the summit of the butte and, seating himself at the edge of the steep quarry face, looked down on the place where he had been working. At his feet there was an extensive platform—the quarry floor—on one corner of which, like a postage stamp on a letter, there was a square of freshly exposed rock. Here was his excavation, following a rich stratum of fossil bones back into the hill.

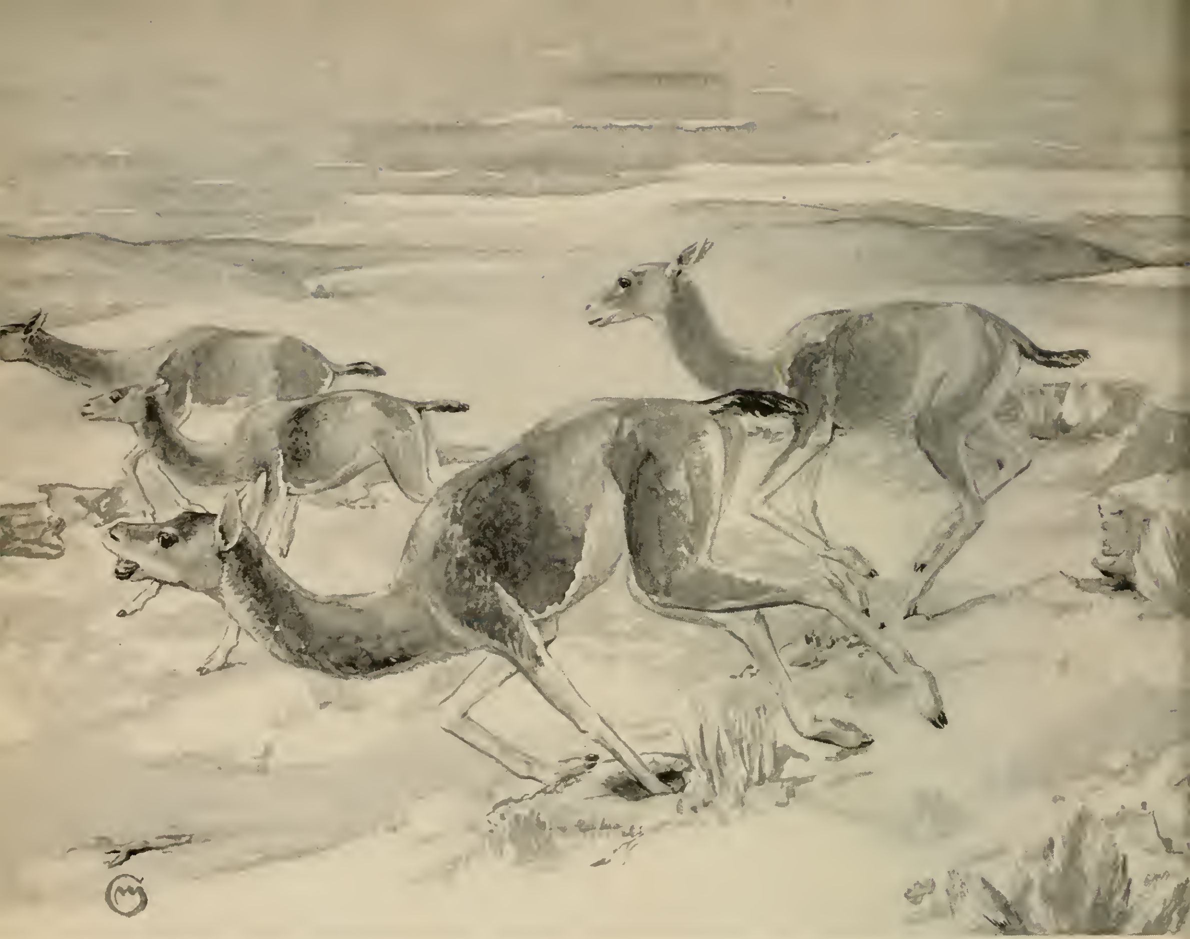
Shielding his eyes against the dazzling brightness of the sun, he peered out across the broiling plains. In a shallow valley near by flowed the Niobrara River, occasionally bordered by scattered cottonwoods that traced green serpentine lines through the yellow grass. Beyond were innumerable low buttes and escarpments that glittered in the hot light and stretched away, mile after mile, to meet the edge of the blue sky.

He looked down at the river, flowing serenely toward the Missouri, just as it had been flowing for countless years in the past. "How insignificant that stream would seem to be in the general scheme of things" he thought to himself, "and yet it is the only timeless thing in the land. Mountains rise, and are worn away by the action of rivers and streams, plains are cut into badlands, and in turn the badlands are leveled into new plains, life evolves and changes, yet the work of water goes on without ceasing. What stories that stream and the streams that flowed before it might tell of the world as it used to be—what they might have seen of the life that now lies buried at my feet, if only one could follow them back and back in time, back to the Miocene, millions of years ago, when those bones down in that hillside were alive!"

* * * * * *

The grass was lush and green, and the sun shone bright and warm, for it was springtime and Nature seemed to be in a placid mood. Across the green plains there roamed a herd of miniature camels, delicate little animals no larger than gazelles. To say that they were camels may create a false impression, because they were more like modern llamas than like camels as we know them. These small, prehistoric camels were graceful of form, with long, slender necks and legs, and slender bodies. The herd moved slowly across the prairie, because the animals were feeding, nibbling off the leaves from low bushes, and cropping especially succulent clumps of grass.

Suddenly, from behind a grassy hummock, two large dogs rushed out on the herd,

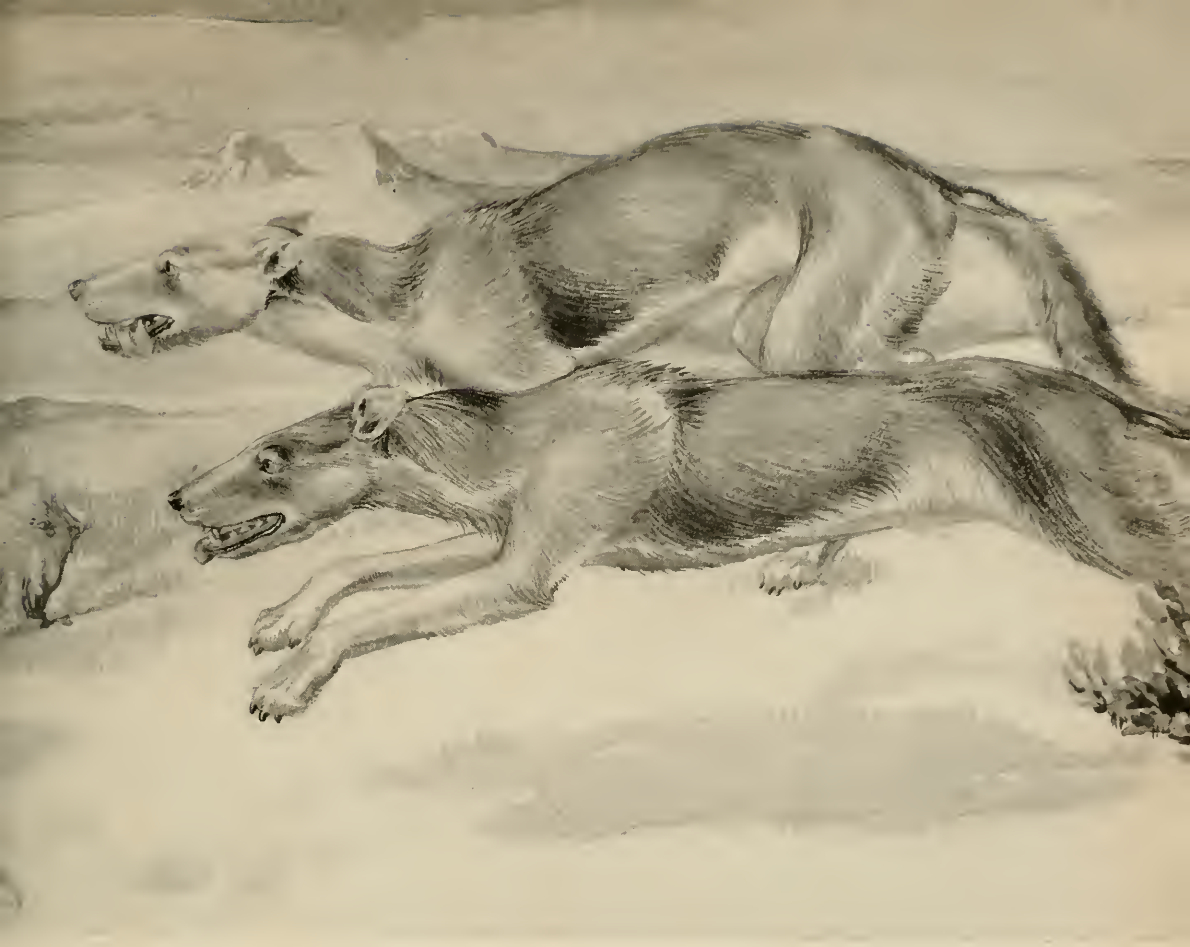


howling as they ran and slavering at the mouth. They were out to kill, and they rushed on like a devastating wind, hoping to run down the herd of gazelle-like camels by the sudden speed of their attack. Their yellow eyes glittered, their white fangs gleamed, the bristles of their rough coats were raised, and their long, heavy tails streamed out behind them as they ran.

The tiny camels leaped away in fright, and like a flash they were off, streaking ahead of the great dogs. For a moment it looked as if the hunt would be of short duration and futile, because the camels were fleet of foot, and the dogs, for all their precipitate haste, were clumsy runners. But just as the camels were getting safely ahead of their pursuers, one of them squealed and hurtled forward, rolling over and over in the dust. He had stepped into a rodent burrow.

In an instant the dogs were on him and the hunt was over. The great "bear dog" of the Miocene, *Daphaenodon*, had secured his food. *Stenomylus*, the little camel, was the victim.

Far across the plain a large *Moropus* lumbered clumsily toward the river. In general appearance this animal looked something like a large horse, at least as much like a horse as like any other animal that may be called to mind. He had a long head with a rather horse-like face, but there the comparsion ends. His body was heavy and was supported by long, thick legs. Moreover, his front legs were longer than his hind legs, thereby causing his back to slope down somewhat from the shoulders to the tail. Yet, as if a heavy, barrel-shaped body held up by long fore limbs and short hind limbs weren't incongruous enough, this animal had, of all things, claws on his feet instead of the usual and expected hoofs. Surely here was a creation of nature that would have been dear to the hearts of the mediæval unnatural historians, those worthy scholars who, in the brave days of the crusades, designed unhappy griffons for the heraldic sheilds of bold knights. *Moropus* was a strange mixture indeed, a grazing animal



Bear Dogs and Camels

A Miocene chase in northwestern Nebraska, some fifteen million years ago. *Daphaenodon*, the great "bear dog" is pursuing *Stenomylus*, the small gazelle-like camel

related to our modern horses and rhinoceroses, but with clawed feet of peculiar and aberrant structure.

Moropus went along sniffing the ground. Suddenly he stopped and began to dig in a most efficient way with his great, clawed feet. The dirt flew out in a fusillade of black clods and gritty stones, making a great clatter in the grass. A little rodent, disturbed in his midday meditations within a near-by burrow, came forth like a beadle out of a library, and began a furious chatter, swearing at his disturber with the richest and most violent epithets in his vigorous, if limited vocabulary.

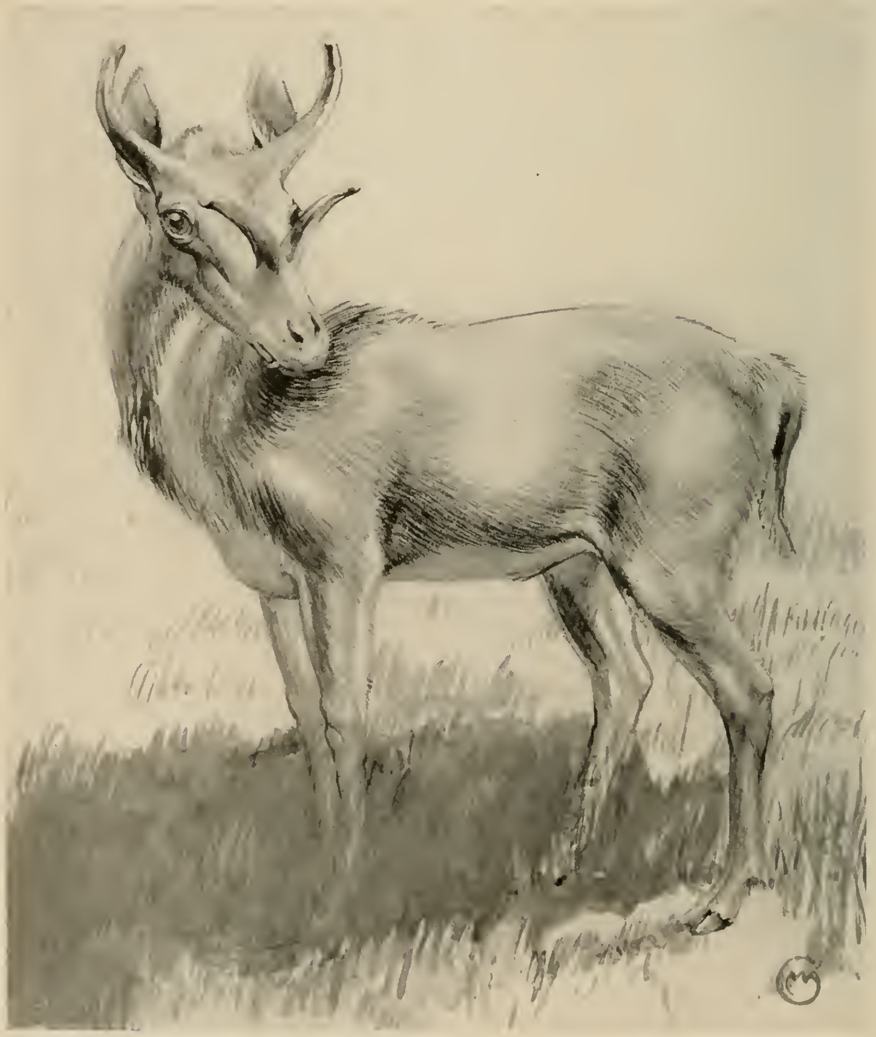
Moropus paid little heed to the heckler in front of him, but kept scratching away until a large, white tuber was exposed to view. This he pulled up with his heavy claw. Then putting his head down, *Moropus* grasped the tuber between his teeth and began to chew it with an air of great satisfaction, all the while looking around as if to determine a spot to prosecute further excavations for dainty morsels. And all the while *Steneofiber*, the little rodent, chattered on in a loud and strident voice.

Moropus wandered on, and *Steneofiber*, assured that he had achieved a tactical victory, started to retreat to the haven of his burrow. But he was not to retire in silence to his subterranean seclusion. Another visitor had come to disturb the peace of his life.

This newcomer would seem to be a small, antelope-like creature, about comparable in size to a very small deer. As a matter of fact it was more nearly related to the giraffes, but even at that the relationship was not close. The peculiar thing about *Syndyoceras*, for such was this animal's name, was the fact that he had four horns on his head. There was a back pair above the eyes, in the usual place for horns, but then there was a front pair on the nose of this beast. Which of course made *Syndyoceras* a peculiar looking animal—if not to another *Syndyoceras*, at least to us and to our way of thinking.

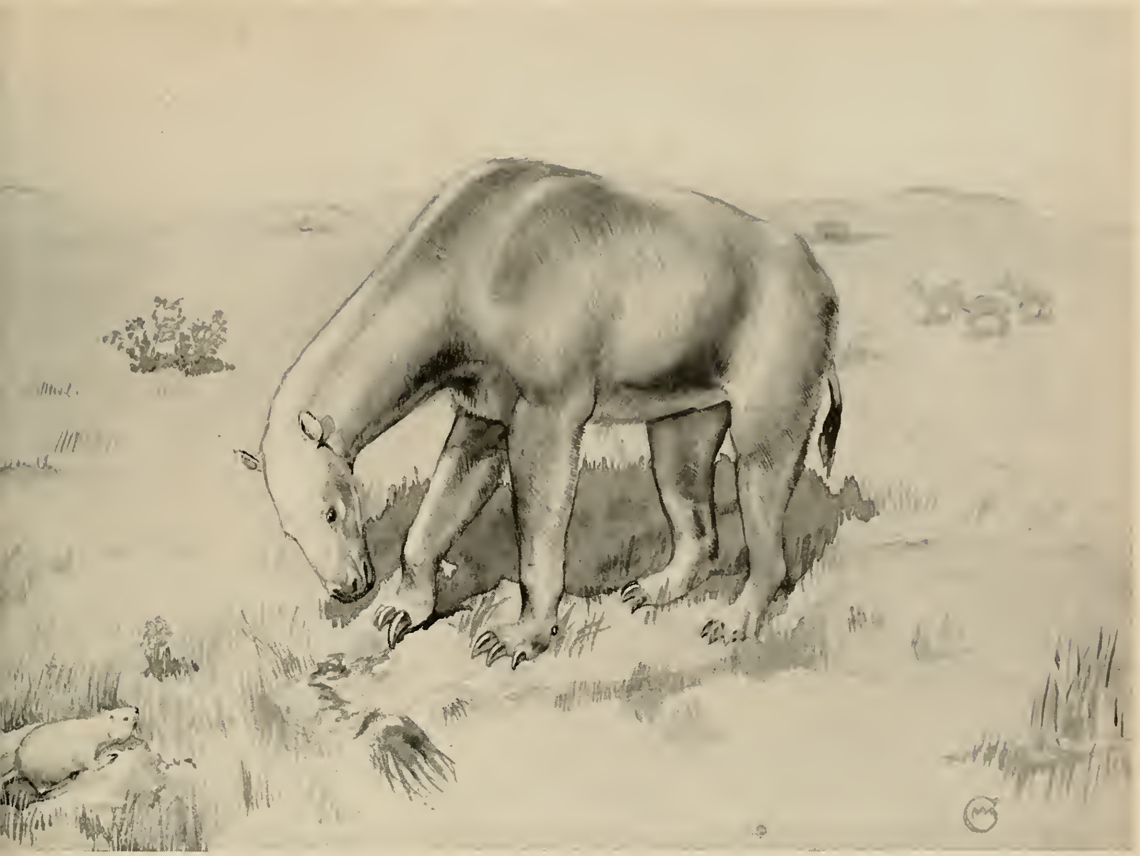
Syndyoceras nibbled at a few tufts of grass and then moved on toward the stream that had lured *Moropus* before him. He departed over the plain, keeping his eyes and ears alert for potential enemies, followed by a blistering string of oaths from *Steneofiber*.

There was a sound of loud cracking and the breaking of branches in a small clump of willow trees near the stream. Grunts and squeals of philharmonic magnitude smote the air, as several giant, long-legged, piglike animals, with vociferous manifestations, scratched their backs and rubbed their sides against the rough tree trunks. To say that these animals were pigs would hardly be a correct description of them, but they were more nearly related to our modern pigs than to any other animals that are familiar to us. They were as large as bison, standing five or six feet in height at the shoulder, and their legs were long, well adapted to rapid running. They had



Four Horns

Syndyoceras, the four-horned ruminant of Miocene times. This animal somewhat resembled the antelopes of today, but was in reality more nearly related to the giraffe



Dinner and Oratory

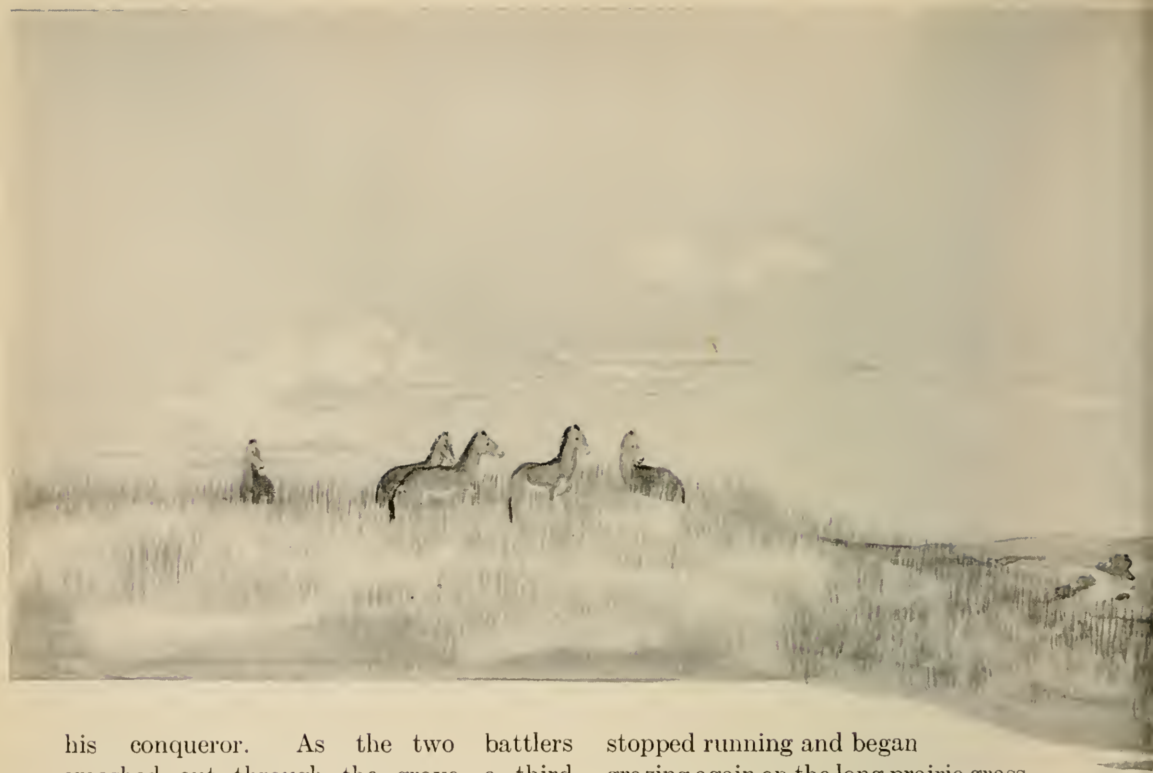
Moropus digs up roots while *Steneofiber* sits at the edge of his burrow and makes a few choice remarks. *Moropus* was a grazing animal, very distantly related to the horse of today but, oddly enough, was equipped with a large set of claws which he undoubtedly used for digging up tubers and roots

tremendous heads, and they were armed with cruel tusks that flashed white in the sun as they rooted in the ground or snapped peevishly at one another.

Dinohyus, the "terrible pig" and ruler of the Miocene prairie, was most certainly enjoying himself in a piggy fashion, through the yellow sunlight of a golden afternoon. His small, mean eyes flashed the evil temper that was inherent within him.

Two large *Dinohyus* boars had evidently been at outs with each other for some time. Neither would tolerate the other within biting distance, and an even moderately close approach of the two to each other was signalized by much growling and showing of teeth. One of these boars, in rooting around under the trees, uncovered a large snake, which he promptly killed. Then he began to devour it with noisy satisfaction, and that was too much for the self control of his antagonistic companion. This second boar decided that he would "muscle in" on the feast, and right there he made a big mistake. With a roar the first boar charged, tusks bared, eyes glittering, and bristles up. Instead of turning to run, the second boar threw himself at his enemy. The fight was on.

There was a blur of gigantic forms as the two adversaries met. Tusks and hoofs flashed in the sunlight, and the dust arose in clouds, partly obscuring the combatants. Truly it was a battle of titans. The row didn't last long, for the second boar, soon convinced that he had had enough of it, turned and dashed at full speed for the open plains beyond the trees, followed closely by



his conqueror. As the two battlers smashed out through the grove, a third *Dinohyus*, one of the reputedly gentler sex, calmly walked over to the field of combat and proceeded to encompass the dead snake.

The noise of the boars fighting caused a herd of three-toed horses, small animals no larger than sheep, to stop grazing and to peer inquiringly at the clump of trees. As they watched with equine wonder, the two boars charged out on to the plain, heading directly for them. With shrill whinnies of alarm the horses wheeled and sped off ahead of the *Dinohyus* boars, and here was the strange spectacle of horses no bigger than sheep fleeing ahead of boars as large as bison.

The flight, like the fight, ended abruptly. The pursuer suddenly stopped short, turned and ran back to his unfinished dinner, which by this time was resting inside of pig number three, while the pursued, seeing that he was no longer the object of dinohyine wrath, swung about and followed his antagonist back into the grove.

Meanwhile, the herd of *Kalobatippus*, the little three-toed horses, having realized that their fright was without foundation, had stopped running and began grazing again on the long prairie grass.

A water bird, wading in the shallows of the stream, gave a raucous call of indignation and flapped heavily to a sand bar down the river. It had been disturbed by a large animal swimming toward its feeding ground. This animal majestically steamed into port, and with more haste than ceremony clambered out on to the sand bar. The newcomer was as big as a large hog, and in proportions was not unlike a small hippopotamus. Its body was long and heavy, and its legs were short. The head was very broad at the cheek bones, and there was a rather narrow muzzle. *Promerycochoerus*, an animal distantly related to the modern pigs and looking like nothing imaginable, waded through the shallow water over the sand bar and climbed the near-by bank to join his mate, feeding in the grass among the trees that bordered the shore. Several small offspring of this domestic couple rooted around in the grass by their mother, running forward now and then to partake of some titbit discovered by the parent.

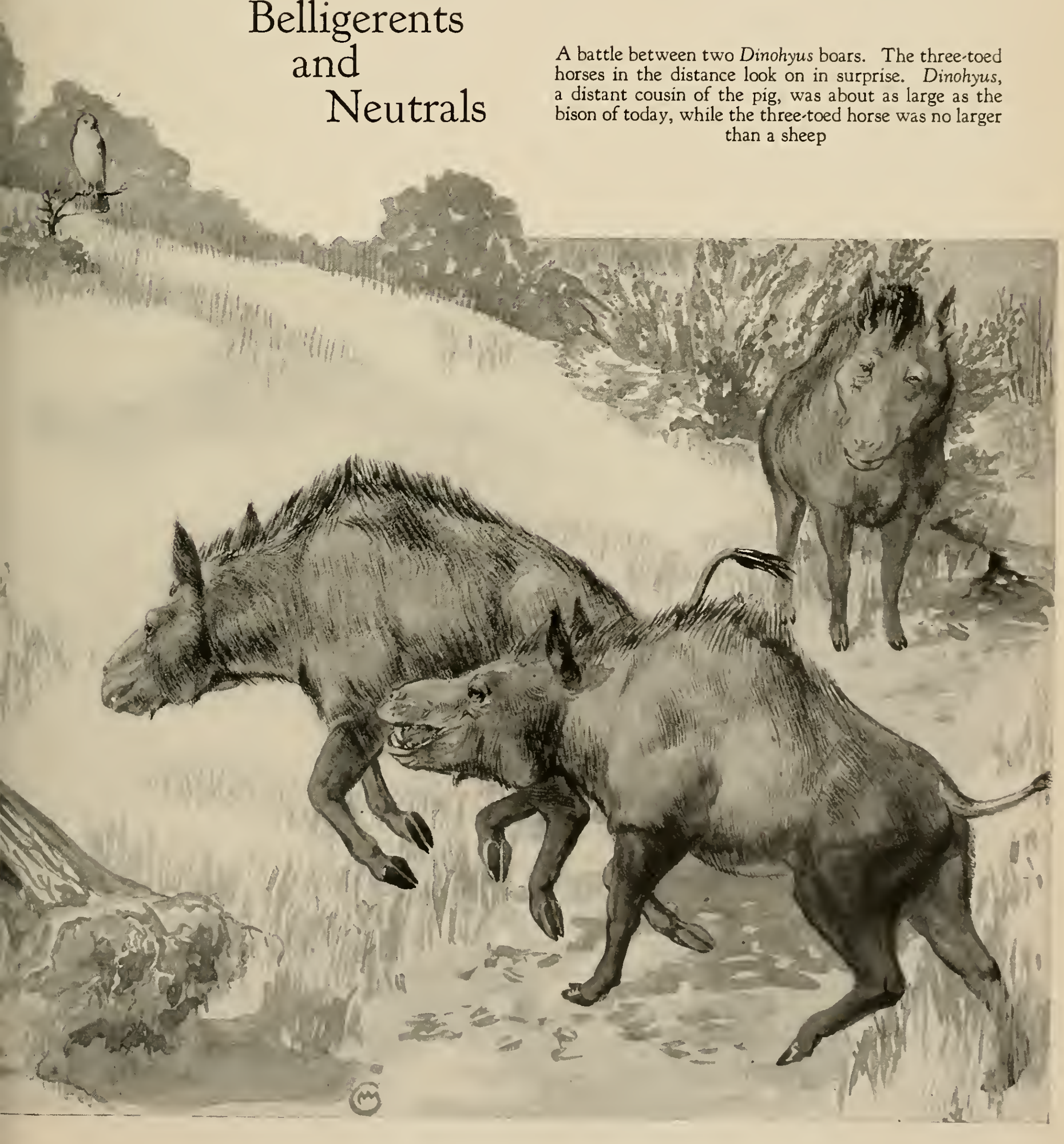
A quick movement in the tall grass near the river bank caused the family of *Promery-*

cochoerus to stop in its quest for food and to look toward the source of the disturbance. Nothing was to be seen, nor were any smells of danger brought to the several wet noses, pointed knowingly into the light afternoon breeze, so the dinner was continued.

A sharp-eyed observer on the opposite bank of the stream, looking toward the water's edge, might have seen a drama of great interest on a small scale. A weasel-like animal about as large as a badger, but with a short face, a heavy body, and robust legs, was crouched, intently watching a tiny shrew feeding near the water. The shrew scurried back and forth, rapidly darting in among the overhanging roots and out into the open patches of sunlight, like an enclosed molecule zigzagging erratically through its own little circumscribed world. Hither and yon it flashed, stopping for a

Belligerents and Neutrals

A battle between two *Dinohyus* boars. The three-toed horses in the distance look on in surprise. *Dinohyus*, a distant cousin of the pig, was about as large as the bison of today, while the three-toed horse was no larger than a sheep



THE GEOLOGIC AGE AND THE POSITION OF THE MIOCENE PERIOD

Quaternary	Recent	Civilized man
	Pleistocene	Stone age man
Tertiary	Pliocene	Modernized mammals
	Miocene (15 million years ago)	Development of modernized mammals
	Oligocene	Beginning of modernized mammals
	Eocene	Ancient mammals
	Paleocene (60 million years ago)	Archaic mammals

brief instant now and then to devour an unwary, and therefore a dead insect.

The crouching carnivore, quite ignorant of the fact that some day he would masquerade under the name of *Paroligobunis*, watched the shrew with eager intensity. Several times he tensed for a spring, but always the shrew darted out of range before the larger animal could make up his mind to jump. Finally, the shrew, unaware that death lurked near by, stopped for a moment in a sun-flecked glade. The carnivore made a leap through the tall grass, but quick as he was, the shrew was quicker, and hungry jaws made a futile snap as the intended victim disappeared in the protection of a mass of tangled roots.

Much snorting and stamping announced the fact that a herd of rhinoceroses was approaching the river. These were small rhinoceroses, no larger than Shetland ponies, and they were light of body and limb, evidently speedy runners in any kind of a race. They were rather unusual, too, in that they had two horns side by side on the nose, a departure from the usual rhinocerine plan, whereby the horns are arranged in tandem fashion, one behind the other. *Diceratherium*, the two-horned rhinoceros of the Miocene, was coming *en masse* to drink and to wallow in the mud along the river.

The herd was a large one, consisting of a hundred or more individuals, and it stretched in a scattered file out on to the grassy reaches of the plain. Just as the bison in later days were destined to roam over this same region in great black herds, so these small, active, paired-horned rhinoceroses wandered across the Miocene prairie. They were perhaps the most common and the most characteristic of the larger mammals of that time.

The herd came on to the river, by twos and threes and in small groups, stopping frequently to graze or browse on the prairie grass and the low bushes, wallowing in the dust, fighting and bellowing. As the tail end of the herd approached the grove that lined the stream, another animal herd emerged from the shelter of some low trees at the edge of the prairie. This was a "sounder" of peccaries, small, mean-tempered, piglike animals, fleet of foot and sharp of tusk. Evidently something had startled them, for they came out on the prairie at a run, squealing and grunting. The rhinoceroses knew from experience the temper and the mettle of *Desmathyus*, so they stopped and with considerable respect watched the peccaries dash across in front of them. Then, having let the porcine whirlwind pass, the rhinoceroses continued toward the river, to join their mates, already splashing about in the cool waters.

A golden red sun ball dropped to the western horizon; a Miocene afternoon in western Nebraska was drawing to a close.

"Perhaps," the palæontologist thought to himself, "the herd of *Diceratherium* became mired in the quicksands of the river. Who knows, perhaps tragedy was the sequel to that calm afternoon so many millions of years ago. How may we account for the rich deposit of bones in this hill—the remains of hundreds, or more likely of thousands of individuals?"

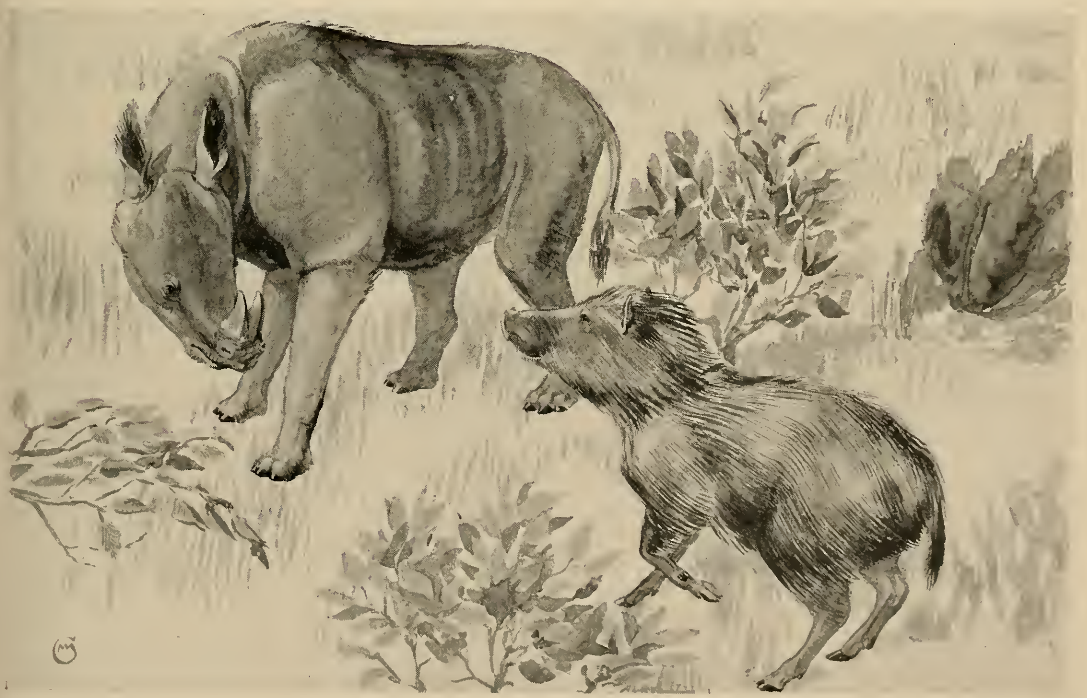
He looked at the white buttes in the distance. The sun had passed its zenith and was now beginning its long journey to the west. The land was empty, and except for a hawk wheeling in the brilliant blue sky, not a living thing was to be seen.

How Scientific Names Are Derived

People often ask why fossils have such "jaw-breaking" names. It seems to the average lay reader that the scientist is being a bit pedantic when he insists on using unfamiliar names for fossil animals. The explanation is that these animals have no other names than their scientific ones; consequently these scientific terms must be used in speaking of the animals. Since these scientific names are derived mainly from Greek and Latin stems, they appear difficult to the average reader. Most fossil animals have scientific names applied to them, but they lack popular names, because the application of popular names to these extinct animals would require the invention of innumerable new and confusing words in every language.

Below is given a list of the animals described in the foregoing sketch, and the meanings of their names. A knowledge of the derivation of the name helps in remembering it.

Daphaenodon (Greek). daphaenos—predaceous; odon, odontis—tooth: predaceous



An Unexpected Meeting

Desmathyus, the Miocene peccary, encounters his neighbor, *Diceratherium*, the small, swift, two-horned rhinoceros tooth. Referring to the sharp, carnivorous teeth of this animal.

Desmathyus (Greek). desmatos—a bond or tie; hyos—a pig: related to the pigs. In allusion to the zoölogical position of this animal.

Diceratherium (Greek). di—double or two; ceros—horn; therion—wild beast: the two-horned wild beast. Descriptive of the paired horns on the nose.

Dinohyus (Greek). dinos—terrible; hyos—pig: terrible pig. A name descriptive of the great size and the supposed ferocity of this animal.

Kalobatippus (Greek). kalobates—stilt walking; hippus—horse: horse walking on stilts. In allusion to the elongated feet.

Moropus (Greek). moros—sluggish or clumsy; podos—foot: sluggish foot or clumsy foot. A term distinguishing this animal from the normal hoofed animals, in which the foot is adapted to swift running.

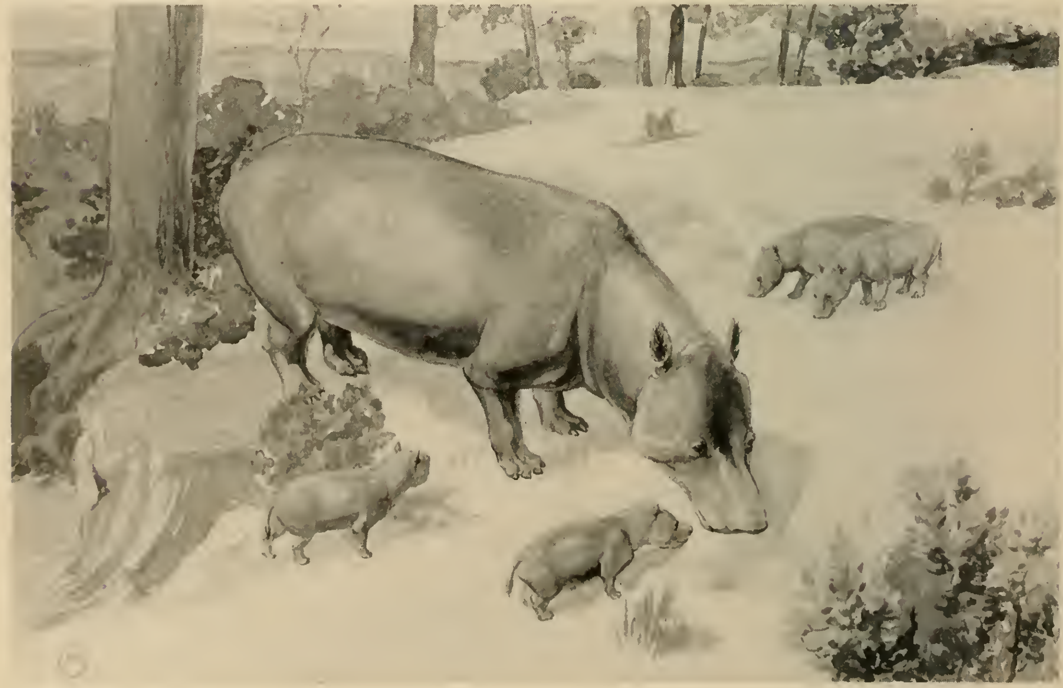
Paroligobunis (Greek). para—beside or near; oligos—few or little; bunos—mound: A name descriptive of the teeth of this animal.

Promerycochoerus (Greek). pro—before; merycos—ruminating animal; choeros—hog: antecedent to the ruminating hog. A name applied because this animal is ancestral to *Merycochoerus*, the "ruminating hog."

Steneofiber (Greek and Latin). stenos—little; fiber—a beaver; little beaver. A term expressive of the size and the zoölogical relationships of this animal.

Stenomylus (Greek). stenos—little or narrow; myle—a mill (grinding tooth): narrow grinding teeth.

Syndyoceras (Greek). syndyos—two together; cero—horn: joined horns. In allusion to the front pair of horns, joined at their bases.



A Miocene Family

A mother *Promerycochoerus* and her young. These water-loving animals often came down on the plains to graze. The adults were about the size of a large hog

Keeping Time

The intricate studies and equipment upon which the accuracy of our timepieces is based

by
Frederick Hellweg,
Captain, U.S.N.,
Superintendent, U. S. Naval Observatory,
Washington, D. C.

To most individuals time and its measurement seem simple enough. One winds one's watch, sets it occasionally, and the matter is cared for. But the accurate determination of time is, for all that, a very complex matter, in which only certain scientific laboratories are competent to act. In reality the matter is largely in the hands of governments—in Great Britain at the Greenwich Observatory, a governmental institution, and in the United States at the United States Naval Observatory in Washington. These two outstanding observatories not only determine time accurately, but also have equipped themselves to broadcast, a number of times each day, radio signals that make it possible for anyone in the world to check with absolute accuracy the timepiece at his disposal, merely by tuning in his radio receiving set on the proper wave length. Thus sea captains need no longer depend for days or weeks on the supposed accuracy of their ship chronometers, but can, if they wish, check up almost hourly with these official measurements of time, and anyone else, no matter where he may be, may also take advantage of this vastly important service. It is in order to acquaint our readers with the story that lies behind the dials of our clocks, that Natural History *has asked Captain Hellweg to tell of the activities of the United States Naval Observatory in this enormously important work.*—The Editors.

IT would undoubtedly surprise the citizens of the United States to learn how diversified are the various activities of the Naval Observatory.

Probably the one activity which is best known in this country is that of determining and broadcasting the nation's time. There is hardly any one who has not at some time seen a clock in some public office with the well known blue sign, "U. S. Naval Observatory time."

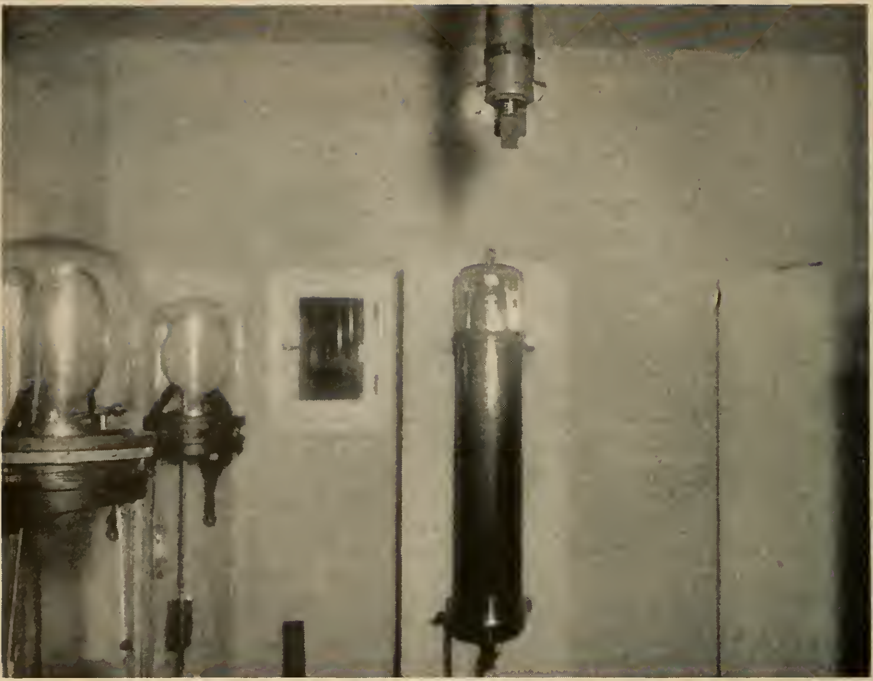
If you should visit some small, isolated telegraph station out on the western plains about the time that the tick comes in by wire, you would be surprised and probably much amused at the intense interest shown in the time and the heated discussions that occur over whose watch is nearest right.

How many times a day do you think some one asks, "Please give me the correct time?" You know the Western Union Telegraph Company had to stop answering that question because it was interfering so seriously with their legitimate business.

The French have recently invented a telephone robot which automatically gives everybody the time. All you need to do is to call a designated phone number and as soon as the connection is made, this automatic device gives you the exact hour and minute of the day. But the expense of such an apparatus must be tremendous, and the question is whether the expense of maintaining such an apparatus is warranted.

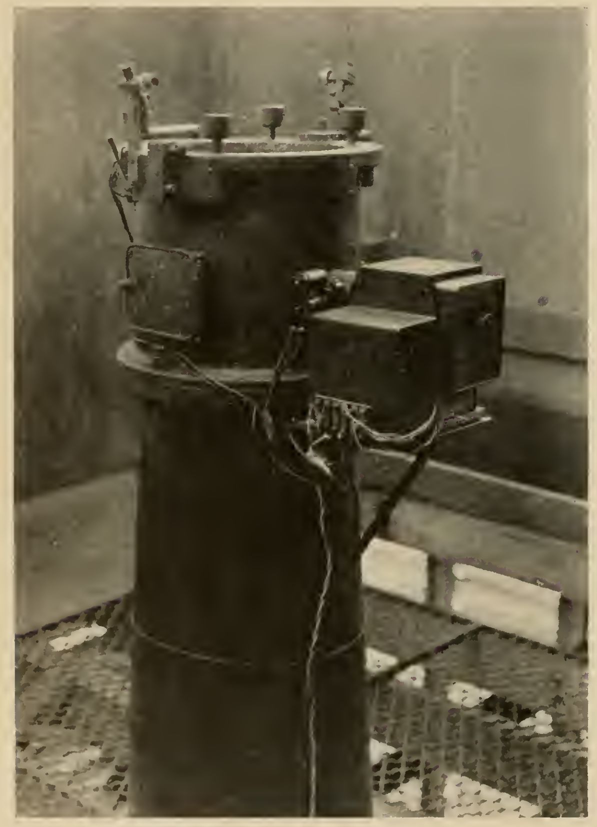
The history of time determination and of the maintenance of time extends back for centuries, long before clocks were ever known, but unfortunately this article is too limited to devote space to a discussion of the history of time.

The most accurate timepiece in the world is the earth. That may sound astonishing, but it is nevertheless a fact. The accepted basis for time measurement is the earth's rotation on its axis. The rate of the earth's rotation is assumed to be uniform, although it is affected by several factors which need not be discussed here. This rotation of the earth causes the sun, planets, and stars to appear to cross the sky from the east to the west. If you were located on the earth's equator and measured the time between the successive passages of some distant star over your meridian, you would have the interval



ARNER & SWASEY
CLEVELAND, OHIO

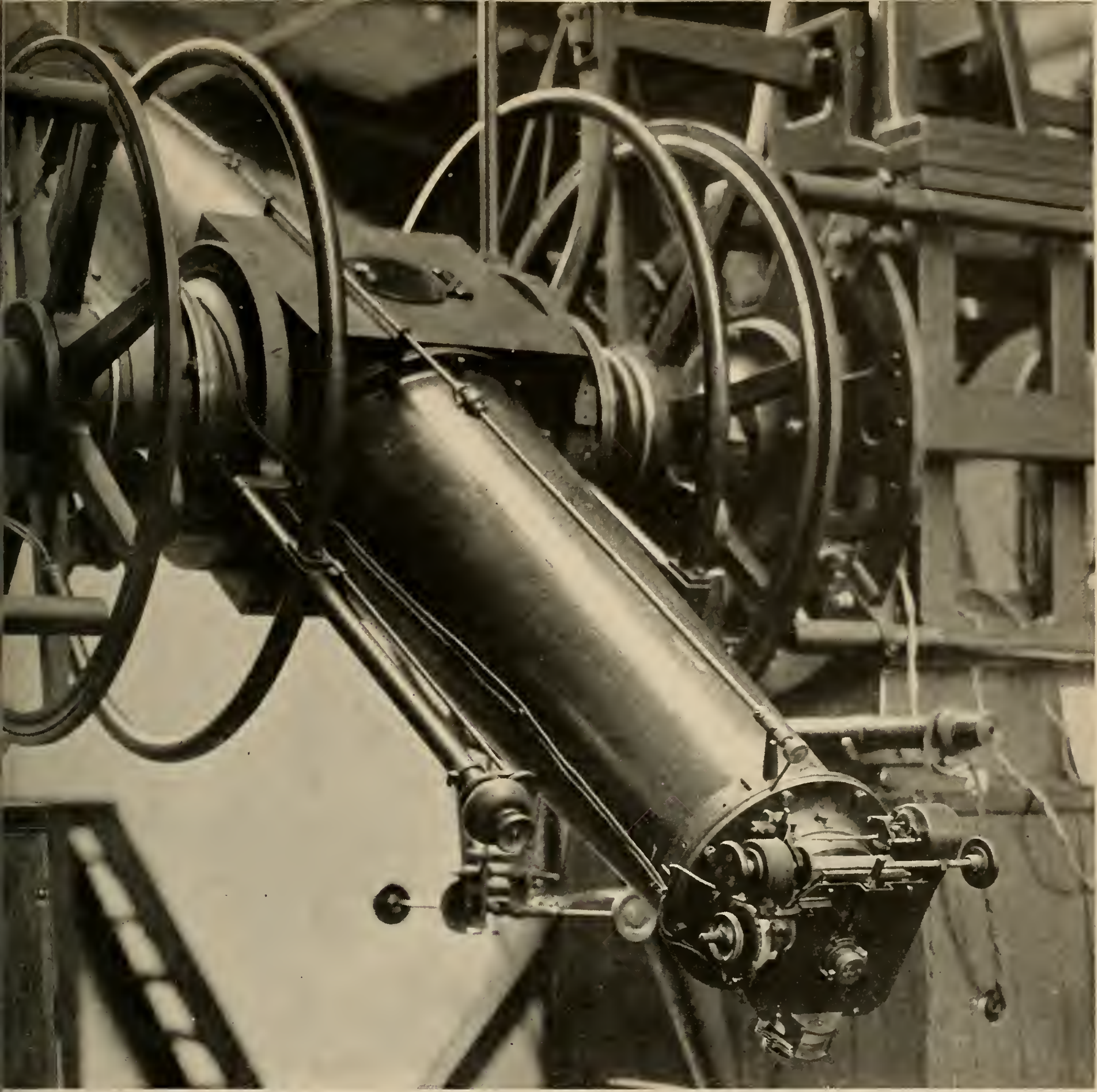
The inner chamber of the new clock vault. This carefully designed room is safeguarded in every possible way from changes in temperature. The observers do not enter the room in order to read the clocks, but, instead, look at them through the inverted periscope shown at the top



The "photographic zenith tube." A series of photographs of heavenly bodies is made automatically by this instrument, and, by careful measurements, the time is determined with extraordinary refinement

At the United State

The scientific observations requisite for the accurate determination of time are, so far as the United States is officially concerned, carried on in the Naval Observatory, where a corps of scientists is constantly engaged on the problem



aval Observatory

The large picture above shows the six-inch transit, with its synchronous motor-driven impersonal micrometer. The house in which this instrument is installed is shown at the right

which accurately measures the period of the earth's rotation, or one day. If you then made the same measurements, using the sun instead of a star, your result would differ about four minutes from the star interval. This difference in the interval for the earth's rotation as measured by the star and by the sun is due to the earth's motion around the sun. This continuously changes the apparent place of the sun among the stars. Thus, during the course of a day, the sun appears to move a little to the eastward among the stars so that the earth must rotate on its axis through a little more than 360° in order to bring the sun overhead again. Even if the earth did not rotate at all on its own axis, the sun would rise and set once during the year because of the earth's journey around the sun. However, the stars are not within our orbit and, as they are millions of times more distant than the sun, their apparent positions are only very slightly affected by the earth's motion in its orbit.

Mean Solar Time

The apparent positions of the stars in the sky are reckoned with reference to an imaginary point in the heavens called the "vernal equinox." The vernal equinox is the intersection of the celestial equator and the ecliptic. The sun is at the vernal equinox at the beginning of spring. At that time it passes over the earth's equator on its journey northward. The period of time of the earth's rotation measured with respect to the vernal equinox is a sidereal day. The period of the earth's rotation measured with reference to the sun is called "an apparent solar day." The sun and the equinox move at variable speeds among the stars, and consequently the apparent solar and sidereal days are of variable lengths. In order to overcome this irregularity and to permit mechanical clocks to be made which can keep time accurately, astronomers had to have recourse to a fictitious time called "mean time." Mean solar time, which is the time generally used in ordinary life, is sometimes ahead of apparent solar time and sometimes behind it. The difference between these two times is called "the equation of time" and its maximum value is a little over sixteen minutes.

Standard Time

Owing to the differences in geographical position, the sun naturally cannot rise and set in different parts of the world simultaneously. From this it is evident that the various parts of the world have different solar time. In order to reduce confusion and to establish a standard measure of time, an international convention established what is known as "Standard Time Zones." All points in each of these zones use one uniform time. This standard time cannot differ from the apparent local time by more than one half hour. In the middle of each time zone the local apparent time is exactly the same as the standard time. The width of each of these zones is 15°. If you divide 360° (which is the value of a total circumference), by 15°, you will find that it gives you exactly 24, which is the number of hours in a day. These standard time zones make it possible for the Observatory to broadcast the nation's time for the fifth time zone, or what is known as the 75th meridian time. The United States covers plus 5, plus 6, plus 7, and plus 8 time; that is, five hours, six hours, seven hours, and eight hours after Greenwich which by international agreement is considered the prime meridian of the world.

By this zoning arrangement, those who receive the time signal by radio all catch the same signal, and the one who lives in the sixth time zone, or approximate longitude of 90°, knows that his time is one hour earlier than the Washington time, or the 75th meridian time. In the same way, any one receiving the signal in San Francisco in the eighth time zone knows that his time is three hours earlier than 75th meridian time. This arrangement permits the Naval Observatory to broadcast signals all over the world, and any vessel at sea picking up the signals knows the exact time for the 75th meridian and at Greenwich Knowing the exact Greenwich time, he can make his astronomical observations and determine his exact longitude.

In order to assist you, the following tabular form is given:

GREENWICH HOUR	STANDARD TIME EASTERN	CENTRAL	MOUNTAIN	PACIFIC
0	7:00 p.m.	6:00 p.m.	5:00 p.m.	4:00 p.m.
3	10:00 p.m.	9:00 p.m.	8:00 p.m.	7:00 p.m.
5	Midnight	11:00 p.m.	10:00 p.m.	9:00 p.m.
8	3:00 a.m.	2:00 a.m.	1:00 a.m.	Midnight
12	7:00 a.m.	6:00 a.m.	5:00 a.m.	4:00 a.m.
15	10:00 a.m.	9:00 a.m.	8:00 a.m.	7:00 a.m.
17	Noon	11:00 a.m.	10:00 a.m.	9:00 a.m.
21	4:00 p.m.	3:00 p.m.	2:00 p.m.	1:00 p.m.

DETERMINATION OF TIME

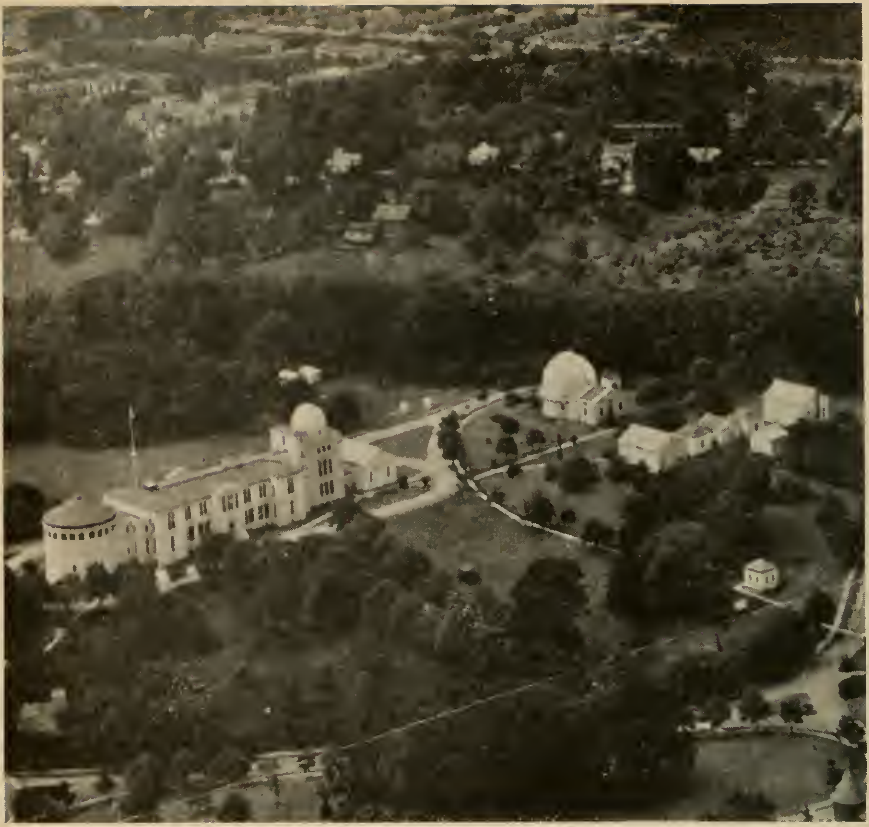
The time determination made at the Naval Observatory must be made with the highest precision possible. Every clear day and night the astronomers at the Observatory repeatedly observe the sun, stars, and planets with the telescope so mounted as to permit movement in the meridian but not at right angles to the meridian. This telescope so mounted is called "a meridian circle" or a "meridian instrument." The difference between these two is that the meridian circle permits the measurement of the declination of the celestial body while the meridian instrument does not.

For a number of years the observations for the determination of time were made visually and the times of the transit of the celestial bodies were recorded by a chronograph. Quite recently, the Naval Observatory developed a new method in the determination of time which has proved very satisfactory. It eliminates the possibility of error due to the personal equation of the astronomer making the observation. After about a year's experimentation with an instrument which had been modified to serve its new purpose, we now make all observations for time photographically. The instrument used is a photographic zenith tube. As its name indicates, it is a tube rigidly fixed in the zenith. It therefore cannot photograph any bodies except those which pass very near the zenith and which therefore come within its field.

The lower illustration on page 48 shows the upper end of this photographic zenith tube. At the lower end of this tube is a basin filled with mercury. The light from the celestial body being observed passes through the lens at the upper end of the instrument and continues on down through the tube to the surface of the mercury. There it is reflected and comes to a focus on a small photographic plate located just below the lens. A series of photographs are automatically made, the plate is measured, and the time is determined with inconceivable refinement. Of course for the average citizen this refinement may appear to be excessive and unnecessary, but do not forget that in addition to catering to all the demands of the citizens of the United States, the Naval Observatory's output is used in every scientific endeavor where time becomes a factor.

THE CALCULATION OF TIME

Observations of the sun are not so precise as are those of stars. Moreover, it is possible to observe a number of stars during one night and thereby increase the accuracy of the work, as averages eliminate or reduce possible individual errors. But in order to make the star observations of value, it is necessary to know the positions of all of the stars in the sky. They must therefore be measured from the vernal equinox. Since the relative motions of the sun and earth fix the position of the vernal equinox, it is apparent that solar observations are therefore a prime requisite. By observing both the sun and the stars regularly over a period



Brown Brothers Photo

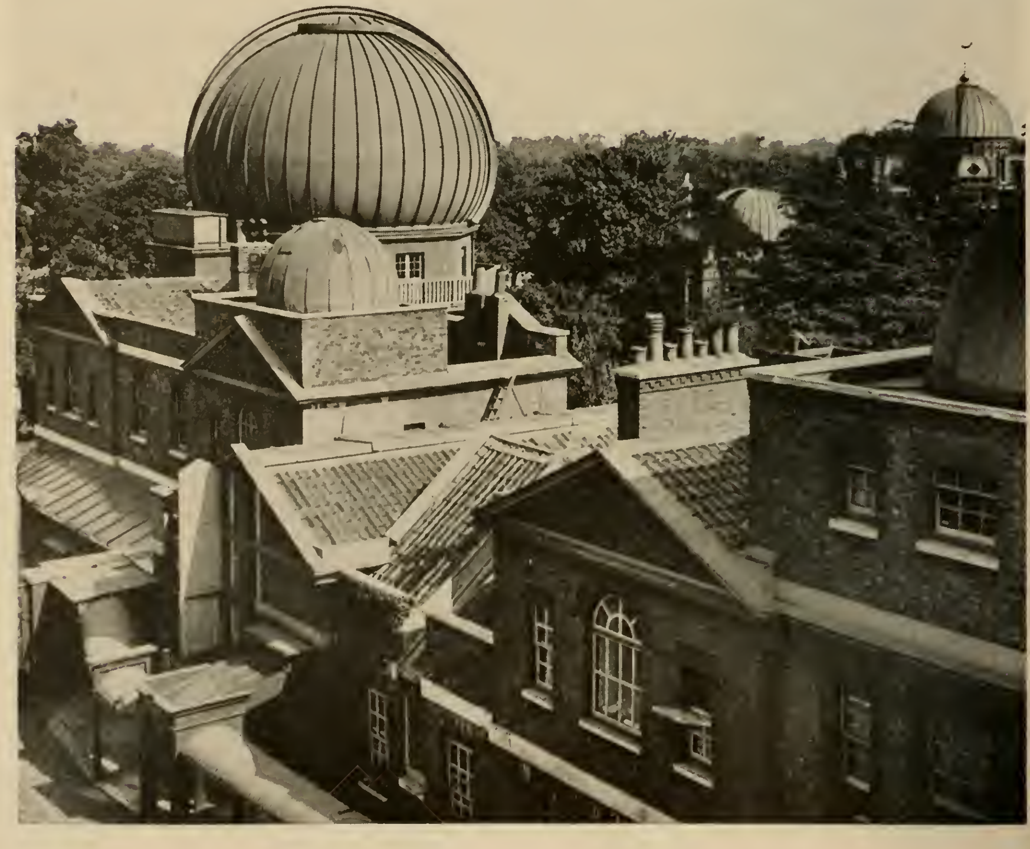
U. S. Naval Observatory

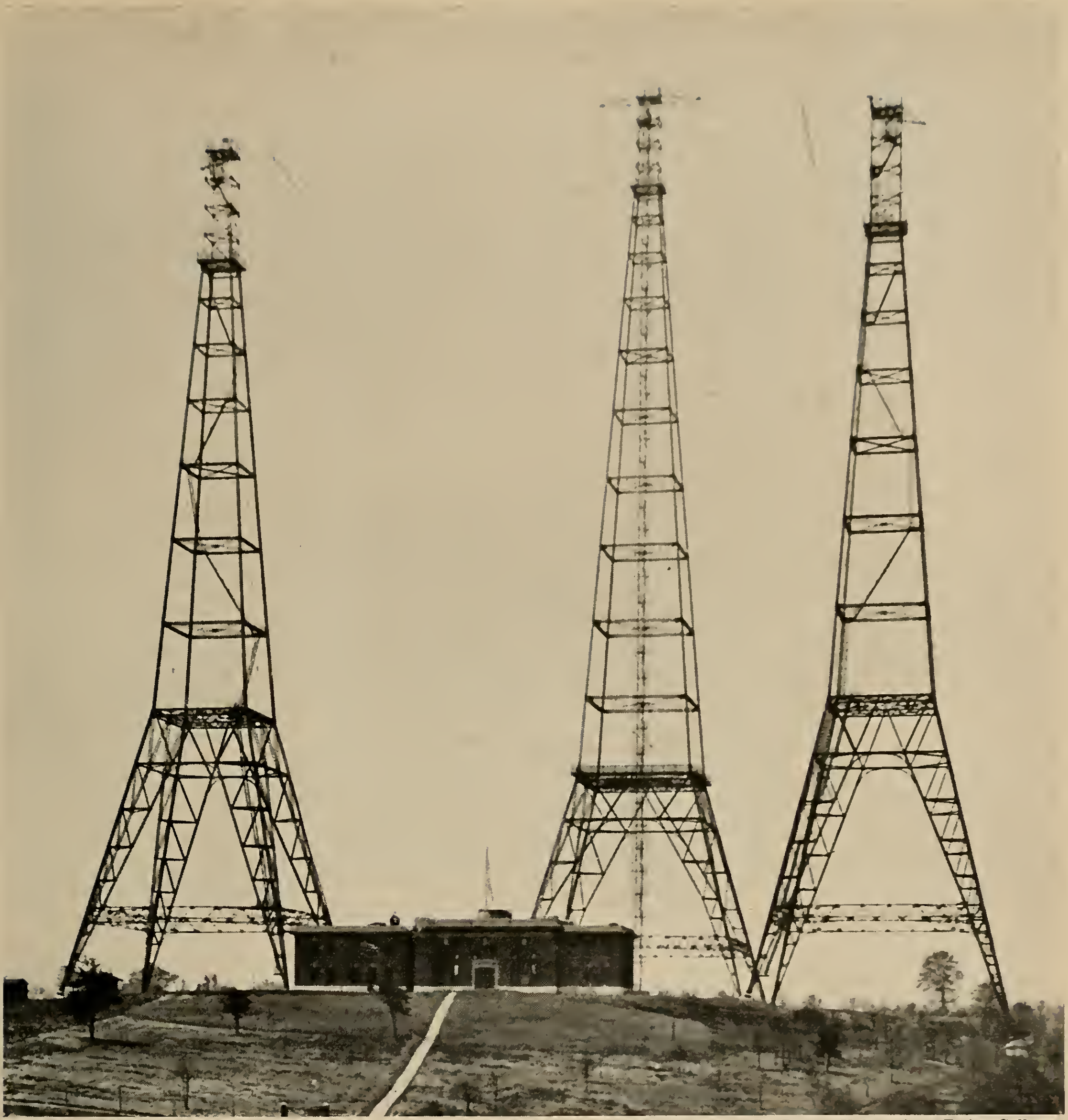
Operated by the United States Navy, and situated in the city of Washington, this institution is the American authority on time

Greenwich

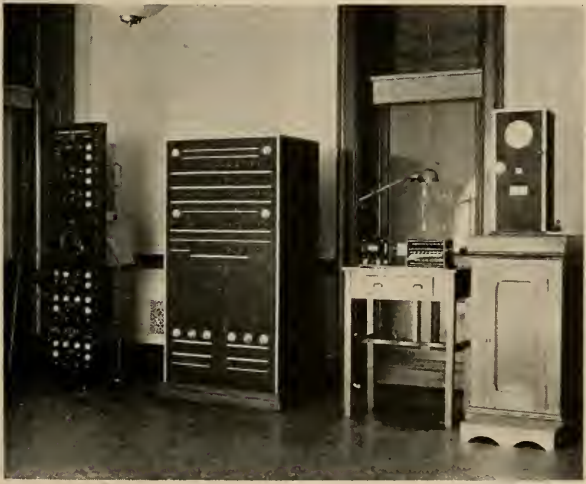
The longitude of the world is almost universally reckoned from the meridian marked by this institution. Built in 1675 for the advancement of navigation and nautical astronomy, this observatory has played an enormous part in the development of these sciences. The accurate determination of time is an important part of this work

Ewing Galloway Photo





By Burton Holmes from Ewing Galloway



Robot and Radio Towers

The small picture shows, from left to right, the oscillator, the special switchboard, and the electrical broadcasting "robot" at the United States Naval Observatory, which regulate the sending of the time signals from the Arlington Radio Towers, shown above of years, it is possible to determine their relation very accurately, and the results of a long series of observations extending over many years are utilized in making the calculations for the reduction of a single night's time observations. The Naval Observatory therefore must maintain a regular program of observations of the sun, moon, stars, and planets.

Tabulated Data

All of these observations are reduced and tabulated. This tabulated data is published annually in two volumes. The large one, called *The American Ephemeris and Nautical Almanac*, contains all the information which is valuable to astronomers and scientists. It gives all the computed positions and motions of all the more important celestial bodies. This book is an absolute necessity in all scientific and astronomical research work. In addition, a second and smaller volume is called merely *The Nautical Almanac*. It contains the tabulated data of the more important celestial bodies which are used by navigators throughout the world for the safe navigation of their ships.

Before leaving this subject, let me impress upon you that if the *Nautical Almanacs* by some trick of magic could all be removed from all of the ships tonight, few ships would dare go to sea tomorrow, for without the *Nautical Almanac* they could not determine their positions at sea accurately and expeditiously, and therefore the ships could be navigated to their destinations only with considerable risk. So when you drink your morning coffee and sweeten it with sugar, remember that if it were not for the *Nautical Almanac*, the coffee and the sugar could not be brought to America except at great risk and slowly. The insurance rates and freight rates would be excessively high, and few people could afford the luxuries or the so-called necessities imported from foreign lands.

In describing the determination of time, it was stated that while the photographic zenith tube is photographing the celestial body crossing the meridian, the clock times for each exposure are recorded automatically. By means of an electrical chronograph, records are made of both the clock ticks and the signals from the photographic zenith tube. By this means, the clock time can be determined within one-thousandth of a second. A comparison of these clock times with the theoretical times computed from the observations determines the errors of the clocks. As the times for the transit of stars are most conveniently computed by sidereal time, the standard clocks at the Observatory are rated to run on sidereal time. These precision timepieces are expensive, elaborate, and must be maintained under the most ideal conditions possible. They are of special design and are made for extraordinary precision. In order to insure the greatest possible accuracy, these clocks must be maintained at a constant temperature and under a constant air pressure. They must never be disturbed. They are never reset, nor are they interfered with in any way, except infrequently when it is necessary to effect repairs. The actual rates of each clock are not so important provided that each is nearly constant. Day by day the rate of each clock is very accurately checked by the astronomical observations described before, and the errors of these clocks can be predicted for any time in the near future. As a result of the refinements in all steps in the determination of time and the maintenance of accurate time, the clock rates of our sidereal clocks can be predicted within a few thousandths of a second per day.

Clock Vault

About two years ago, in an effort to increase the accuracy of the nation's time, a new clock vault was constructed.

On board our battleships, the most carefully guarded compartments are the powder magazines. They are safeguarded in every conceivable way. Therefore, when deciding to build a more accurate, more efficient clock vault, it was decided to construct it like the magazine on a battleship. Then, in order to maintain a constant temperature, it was decided to put this vault in a thermos bottle; and then, in order to reduce the outside variations to which it was subjected, to sink it in the ground below the frost line. The result of this decision was to construct a compartment 12 ft.×18 ft.×9 ft. inside of another compartment completely surrounding the inner one and separated from it by a 2½-foot air space. All walls were built of special material to reduce radiation and to insure constant temperature.

Insurance against Dampness

Again we turned to the Navy's long-established practices in order to insure against dampness or moisture. Each layer of moisture-proofing material was painted on in the successive steps with the Navy's well known bitumastic paint.

The illumination of the inner compartment is effected by typical battleship magazine lights, one of which can be seen in the illustration on page 48 up near the top of the compartment. The illustration shows the individual piers to which are secured the precision timepieces. The one in the center is a Shortt clock, manufactured in England. The two to the left are Riefler clocks of German manufacture.

Please note that in the arrangement of the clocks, no two clocks are mounted so that their pendulums will swing in the same plane. This idea was taken from the U. S. Naval Powder Factory, where the buildings were so constructed that each dry house is in the dead angle of all adjacent houses. In order to eliminate the possible sympathetic influence of pendulums swinging in the same plane, all piers are set at different angles so that adjacent pendulums are swinging at angles not less than 45° from each other.

At the top center of the photograph can be seen the lower end of the periscope. In order to make it possible to inspect all clocks visually daily, a periscope from one of our old submarines was obtained from the Portsmouth, New Hampshire, Navy Yard, and was mounted as shown. This makes it possible for those in charge of the clocks to look down from the office above; and, by turning the periscope, to inspect each clock in turn. In other words, we have reversed the use of a periscope so that instead of looking from the bottom up for something on the surface of the sea, we are looking from the top down to see whether our clocks in the vault below are operating properly.

In the roof of the vault there are two electric controls and in the back of the vault, next to the Shortt clock, is a small compartment let into the back wall which contains another thermostatic control.

The outer compartment is heated by gas and has its own thermostatic control. The inner compartment is heated by electricity and the super-refinements of temperature control are effected by a very delicate thermostat in the left back, near the floor level.

As a result of the construction of this new vault, our temperature curves are straight lines and have been ever since the new vault was placed in commission. With such ideal conditions, it is not surprising that we have clocks that have not varied five thousandths of a second a day in six months.

Time Signals

Although sidereal time is most convenient for the use of astronomers in connection with their star observations, this is not suited for the general use of the public. The mechanism for the transmission of our time signals is therefore rated to mean solar time.

Four years ago the Naval Observatory broadcast three time signals daily. In 1932 this was increased to six signals daily. Recently, as a result of an invention made at the Naval Observatory, it is now possible for the Naval Observatory to broadcast signals hourly. Unfortunately, official broadcasting occupies the time so fully that there are four hours a day when it is not possible to obtain the necessary time to broadcast our time service. This results in the Naval Observatory sending out an hourly broadcast except at 9 A.M., 11 A.M., 9 P.M., and

Without the accurate determination of time the railroads of the world could not possibly operate the intricate structures they have developed

Courtesy New York Central Railroad

Railroads

Every day the arrival and departure of thousands of trains are checked by the watches of thousands of railroad employees. These watches, in turn, are checked against the railroad's official time, which is determined, for the United States, by the scientists of the Naval Observatory

Ewing Galloway Photo

Ships depend upon time not only for the scheduling of departures and arrivals, but also for the determination of their positions when they are at sea

Courtesy Cunard-White Star Line

Steamships

If accurate clocks at two points on the earth's surface show a difference of one hour in time, the navigator knows that the difference in longitude is fifteen degrees. The determination of longitude, consequently, resolves itself into a problem of time. The navigating officer accurately determines the time for his meridian of longitude by taking a "sight" of the sun or a star. His ship's chronometer tells him what time it is at Greenwich. The difference between the two can readily be translated, at fifteen degrees to the hour, into longitude

Courtesy Cunard-White Star Line

11 P.M. This new device developed at the Observatory performs automatically what previously required an astronomer at least fifteen minutes to do before each broadcast. At that rate it would have been impossible, without enormous increase in the personnel, to have broadcast signals more frequently than six times a day. But with this new time broadcast robot, time comparisons instead of requiring fifteen minutes, now require less than five seconds, and after correction, the robot automatically broadcasts signals every hour on the hour.

As there are many of the readers of NATURAL HISTORY MAGAZINE who will undoubtedly want to hear the signals over the air, a brief description is given so that one can identify the signals.

Beginning at the 55th minute of each hour, exclusive of the excepted hours already mentioned, there is an audible signal—a birdlike chirp—for each second of the minute except the 29th second of each minute. This silent second acts as a sign post indicating that the next audible signal is the 30th second of some minute. At the end of each minute, there is a period of silence for the 56th, 57th, 58th and 59th second. This is called the "end-of-the-minute" silence and acts as a pointer so that the next audible signal is known to be the 60th second of some minute. Between the 50th and the 55th second are what we call "the identification silences." The 50th second is always audible. If you note a one-second silence followed immediately by the next four audible seconds which in turn are followed by the end-of-the-minute silence, that indicates that there are four more minutes to go before the zero hour. If you hear the 50th and 51st audible seconds, then a silence, and then an audible 53d, 54th, and 55th second, that indicates three more minutes to go before the zero hour. If the 53d second is silent, you will hear the 54th and 55th, indicating two more minutes to go, and if the 54th second is silent, your hear only one, the 55th second, before the end-of-the-minute silence, indicating that there is only one more minute to go. During the 59th minute, there is a complete silence from the 51st to the 59th second inclusive. So if you hear a long silence of nine seconds' duration, you will know that the next signal you hear will be the zero hour.

During the transmission of the time signals, the radio stations at Arlington and Annapolis are automatically controlled by the private wire from the Naval Observatory. The San Francisco signals are indirectly controlled from Washington and rebroadcast from that station. One of the new broadcasting devices has been installed at Mare Island and permits them to synchronize their broadcast with the radio reception from the Naval Observatory. Congress has been requested to supply funds to construct two more of these time broadcast robots, one for installation at Honolulu and the other at the Canal Zone.

Time signals were first broadcast in order to aid navigators. Years ago the navigators were compelled to compute their errors while at sea and could only compare their chronometers when their ships were in port and

TABLE ILLUSTRATING THE AUDIBLE AND SILENT SECONDS OF THE TIME BROADCAST

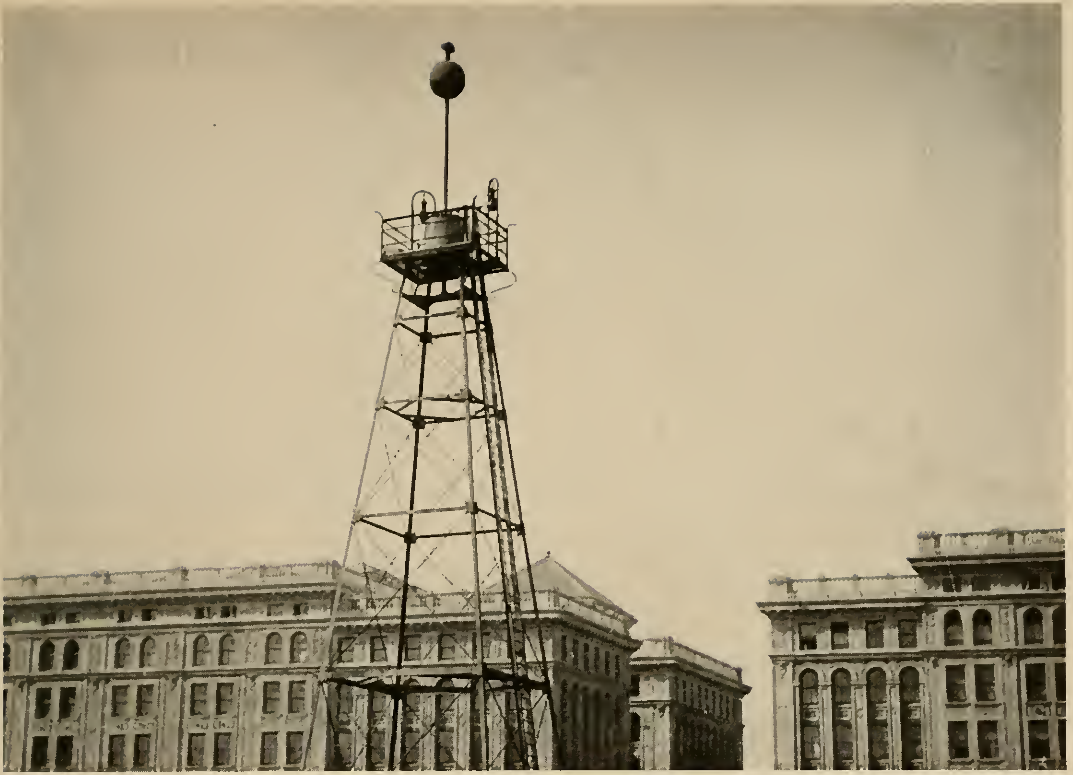
MINUTE	SECONDS OF THE FIVE MINUTE BROADCAST										
	50	51	52	53	54	55	56	57	58	59	60.	
55	—		—	—	—	—					—	(Four to go)
56	—	—		—	—	—					—	(Three to go)
57	—	—	—		—	—					—	(Two to go)
58	—	—	—	—		—					—	(One to go)
59	—										——	

EXPLANATION:

— Indicates an audible signal of standard duration.

—— Indicates the final signal, the zero hour signal, of double duration.

Blank spaces indicate omitted signals, silent spaces used as identification signals.



Brown Brothers Photograph

Time Ball

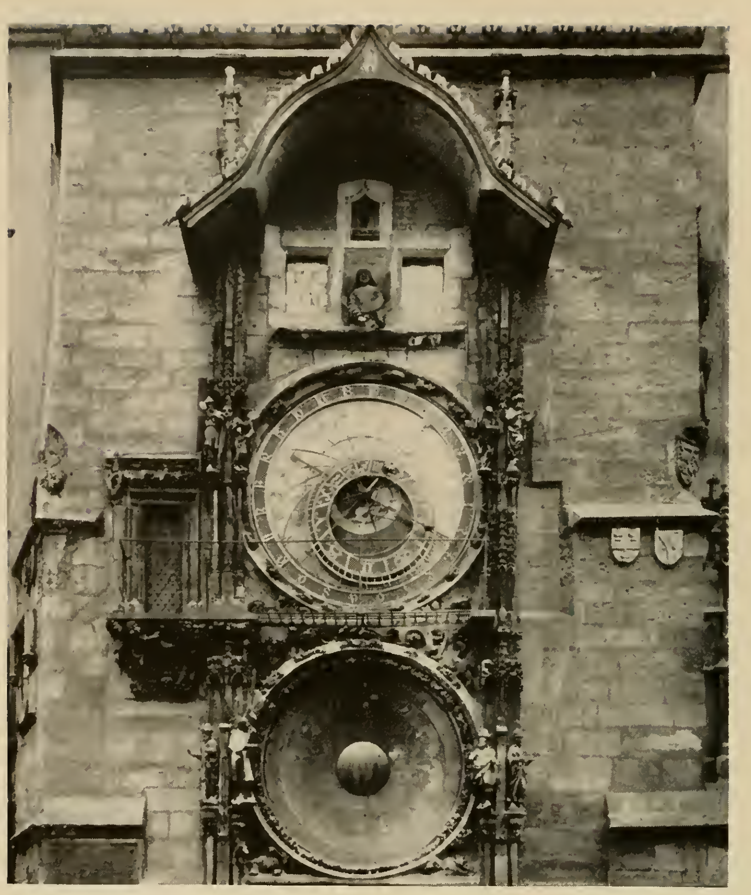
Before radio was brought into play, many cities supplied a daily check on the clocks by means of a "time ball." This ball was pulled to the top of a pole which usually was so placed as to be visible at considerable distances. By means of an electrical contact, the ball was released at an exact time announced in advance—usually at noon—and observers, by watching for the dropping of the ball, could set their timepieces accordingly

Brown Brothers Photograph

Sundial

Brown Brothers Photograph

Hourglass

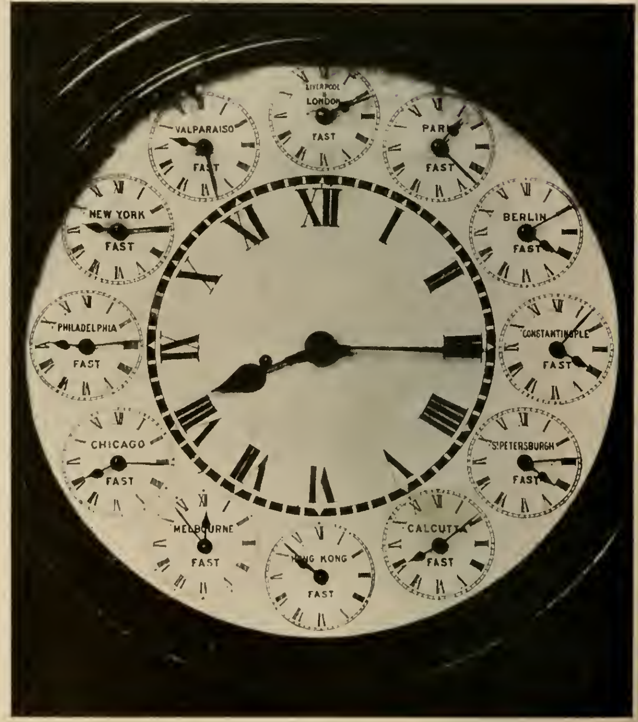


Ewing Galloway

Great ingenuity has often been exercised in the design and construction of clocks. This old clock in the town hall of Prague, Czechoslovakia, was built in 1840. When it strikes, the figures of Christ and the twelve apostles appear in the upper window, while the movements of the planetary system are recorded, and a calendar is also included

Thirteen clocks in one. The central dial gives the time at New Orleans, Louisiana, where this clock is located. The twelve small dials show the corresponding time at twelve other cities of the world. Even a casual examination of the various dials will show, however, that some of them are not absolutely accurate

Ewing Galloway


LIVERPOOL
LONDON
FAST
VALPARAISO
FAST
PARIS
FAST
NEW YORK
FAST
BERLIN
FAST
PHILADELPHIA
FAST
CONSTANTINOPLE
FAST
CHICAGO
FAST
ST.PETERSBURGH
FAST
MELBOURNE
FAST
HONG KONG
FAST
CALCUTTA
FAST

they could hurry to the nearest Western Union Telegraph office and get the noon tick.

In the spring of 1904 the Navy developed its first radio broadcast of time signals. At that early date the broadcasts were necessarily on low power. In 1912, upon completion of the Arlington high power radio station, the Navy inaugurated its high power radio time service.

It should be a matter of considerable pride to all Americans to know that the first American time signal radio broadcast antedated that of the British government by nineteen years, and that the first American high power time signal broadcast antedated the British high power broadcast by fifteen years; in other words, the United States was broadcasting accurate time on high power radio eleven years before the British government began low power time broadcast through the agency of the British Broadcasting Company. This interesting piece of comparative data was taken from the official reports of the Greenwich Observatory in the year 1923, and the later report of 1927.

Of course everybody realizes the vital importance of accurate time signals to the ships navigating the sea and also the importance to our elaborate railroad systems throughout the land. But there is hardly any one who appreciates how the demands of scientific and commercial activities have increased in recent years. Many special uses of the time signals have arisen. These include all of the longitude determinations for precise surveying and for map making. It is interesting to know that gravity determinations by which hidden deposits of oil and minerals are located are dependent upon the time service. Radio monitoring stations are also dependent on our signals, and the seismologists must have our signals in recording and measuring their earthquake tremors.

As a matter of fact, time is such a vital factor and enters into so many important activities in our present everyday life, that the Naval Observatory's time service is just about as important to the national life as the nervous system is to human life.

A Summer Home in Main Street

How a colony of purple martins, largest of the swallow family, takes up residence in the midst of city traffic every year during the nesting season

by
Herbert S. Ardell

SAUNTERING along a few yards below the central square in the city of Harrisburg, Pennsylvania, I noticed a large bird house, containing forty compartments, on a pole some eight to ten feet high erected at the curb. Each cell was occupied. The parent birds were flying unconcernedly amidst the hustle and bustle of street and sidewalk traffic—busy rearing their young.

I learned that on this location the ancestors of this colony of martins began nesting sixty years ago in the wooden awning which extended from the building to the curb line. The late Mr. E. Z. Gross, former Mayor of Harrisburg, purchased this property when he was Commissioner of Parks, and decided to remove the unsightly awning; but, being a bird lover, he did not want to deprive the martins of their nesting place, so he set up this veritable little apartment house for them.

It is rather curious that they would have nothing to do with their new home until some of the boards from the old nests were placed in the new-fashioned domicile for them to alight on.

The time of their arrival in the spring is about the fifth to the tenth of April, when an advance guard of several birds inspects the house. Having satisfied themselves that all is well, these birds leave. In two or three days they return, bringing with them the other birds that comprise this community.

They immediately start to clean house, throwing out all the old material, and begin constructing new nests of straw, twigs, and feathers. Usually four pure-white eggs are deposited and a single brood is reared.

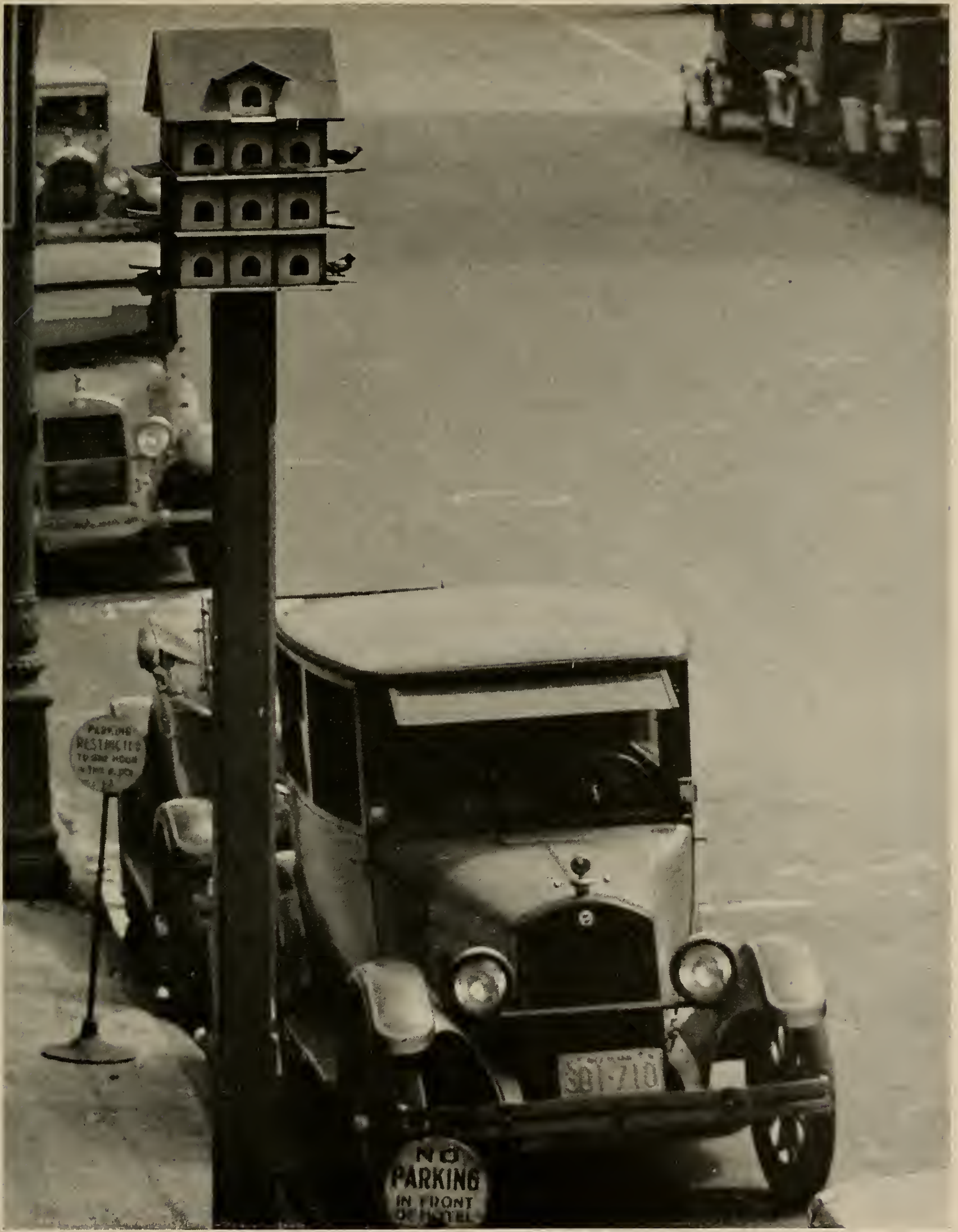
The older birds are very quarrelsome among themselves, and often, when the parents seem to be settling disputes, the young birds are pushed out of their nests before they are able to fly. However, the parent birds are most assiduous in caring for their young.

During the nesting season, the martins remain in the boxlike quarters at night, but after the young are able to fly about, they all leave the house and thereafter spend the nights in dense thickets, and leave with the first appearance of dawn.

Years ago the purple martin nested in hollow trees or in any crevice which would make a suitable nesting place, and it still does so to some extent in certain sections of the country. In this region it has more readily adapted itself to civilization and seems to like a custom-built roof over its head.

Ruskin refers to the swallow's mouth "as a net for the catching of gnats," but this pictures a bird with its mouth constantly open, whereas the members of the swallow family snap at flying insects, and the glutinous saliva in the mouth keeps previous captures from escaping. Ruskin no doubt referred to the European goatsuckers or nightjars, which have a fringe of long bristles along the edge of the bill, thus making a regular insect net. The martin has been accused of catching the honey bee. John Burroughs, in one of his volumes, says "I doubt his guilt."

This largest of our swallows is a welcome guest whose arrival with its young in the springtime is eagerly anticipated, joyfully greeted, and whose departure the latter part of August leaves one as the French say—*au désespoir*.


PARKING RESTRICTED
NO PARKING IN FRONT OF HOTEL

A Curbstone Apartment

Undisturbed by the city's roar, a colony of purple martins takes up its housekeeping duties each spring in the same quarters in one of the busy thoroughfares of Harrisburg, Pennsylvania

Machu Picchu

The most famous Inca ruin has again been cleared by the Peruvian government as part of the archæological celebration of the discovery of Peru

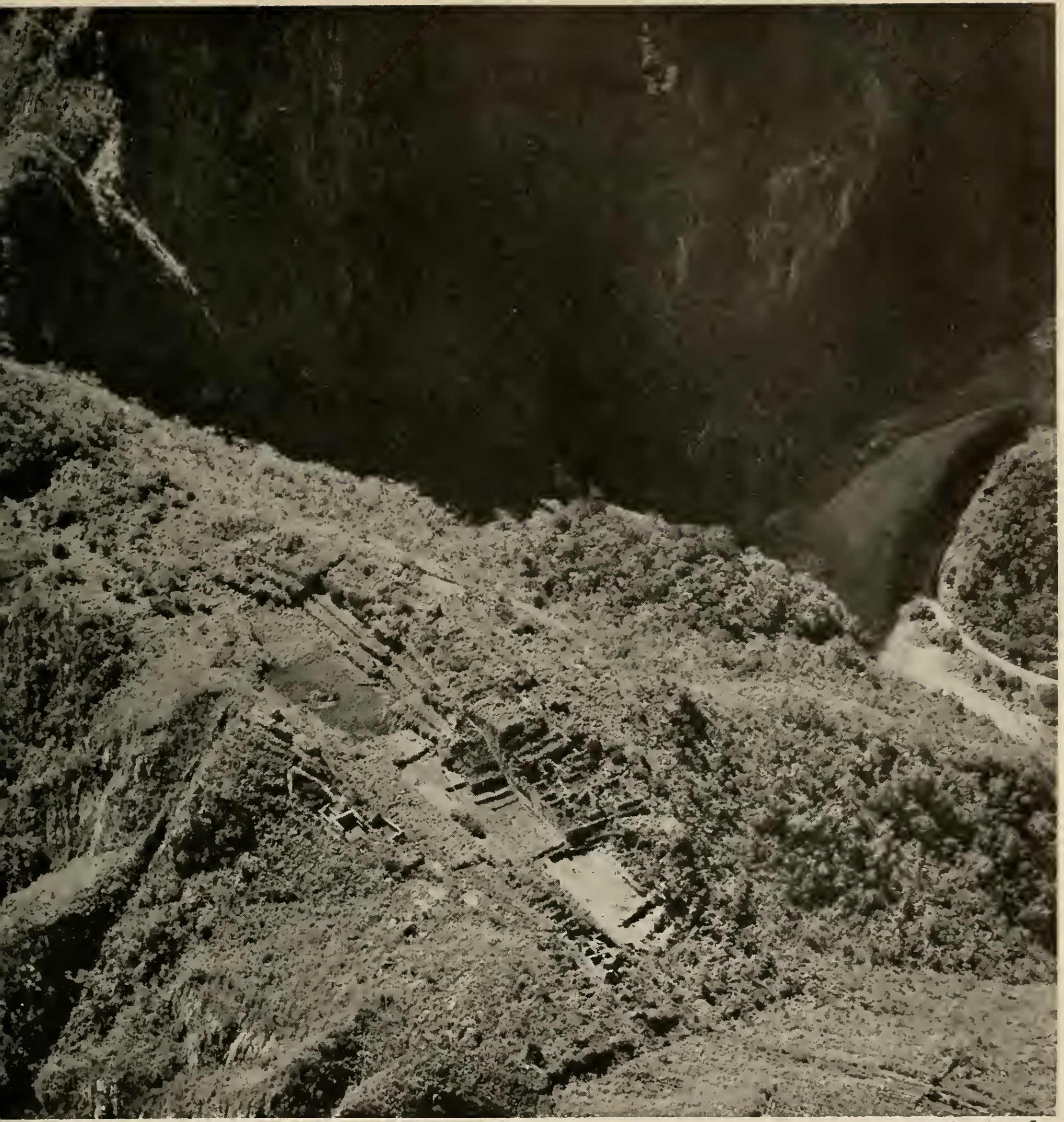
by
Wendell C. Bennett
Assistant Curator in Anthropology,
American Museum

FOUR hundred years have passed since the first Spaniards landed in Peru under the leadership of the dauntless Pizarro. The Inca Empire at that time extended from central Colombia to southern Chile, including all the present countries of Peru and Ecuador and parts of Chile, Bolivia, Argentine, and Colombia. The center or capital of that vast empire was the mountain city of Cuzco. There the Incas had formed their first organization, gradually spreading their military control in all directions. It took the Spaniards only a few years to establish colonial settlements in most of the principal Inca centers.

In commemoration of the discovery and conquest of Peru an extensive program of archæological investigation was inaugurated last year under the leadership of Dr. Luis E. Valcarcel, director of the National Museum of Peru. This program not only included exploration and excavation, but also judicious reconstruction. Naturally enough the concentration of this work was in the Cuzco section.

As many as eight hundred men were employed, not only in the town of Cuzco itself, but also at the fortress of Sacsahuaman, and down the Urubamba river valley at Ollantaytambo and Machu Picchu.

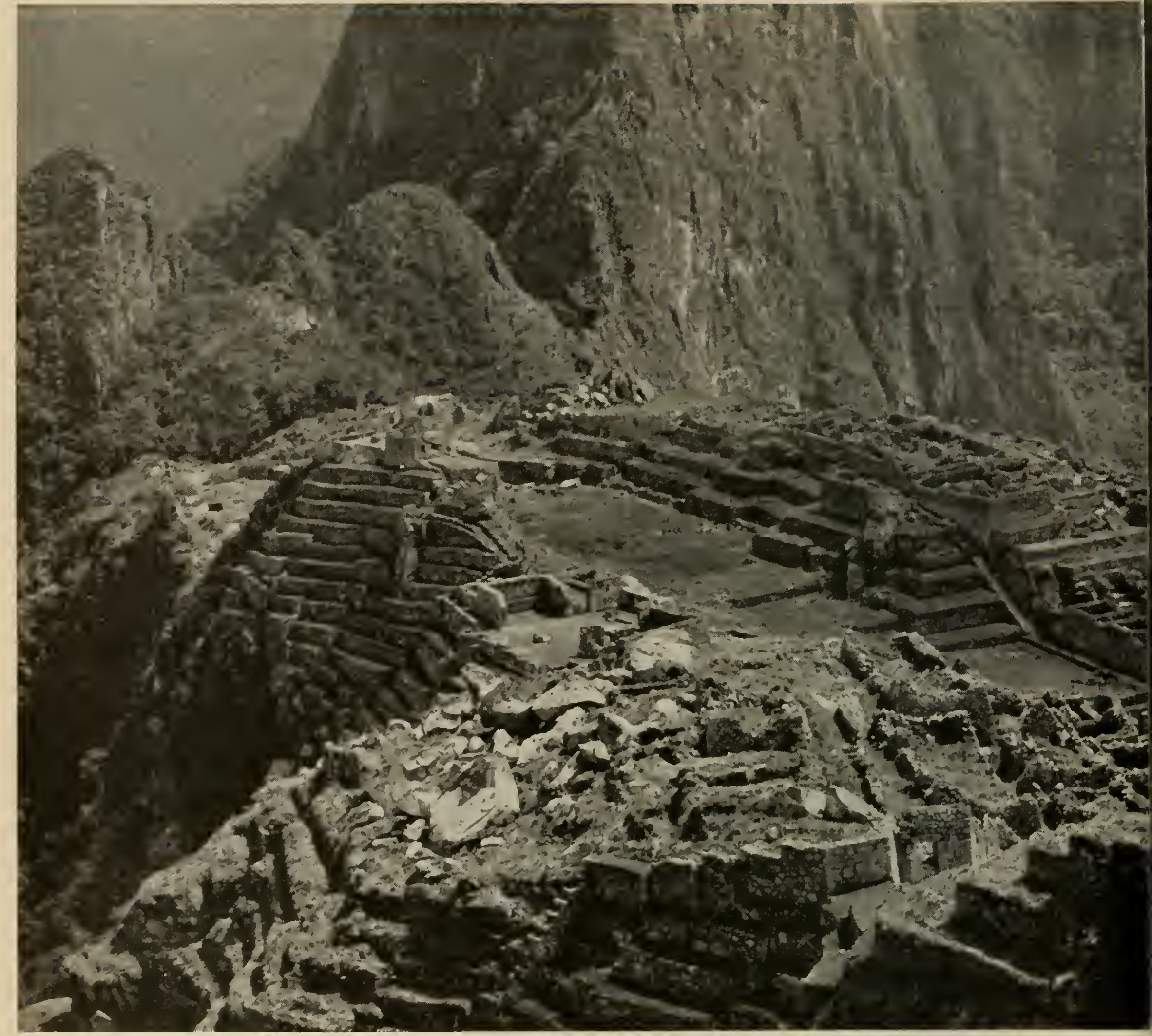
Most of the ruins in Peru have been known for many years. It is true that only a few have been studied intensively, but accounts of varying degrees of accuracy can usually be found in the records of travelers and explorers dating back to the early colonial days. Machu Picchu is an

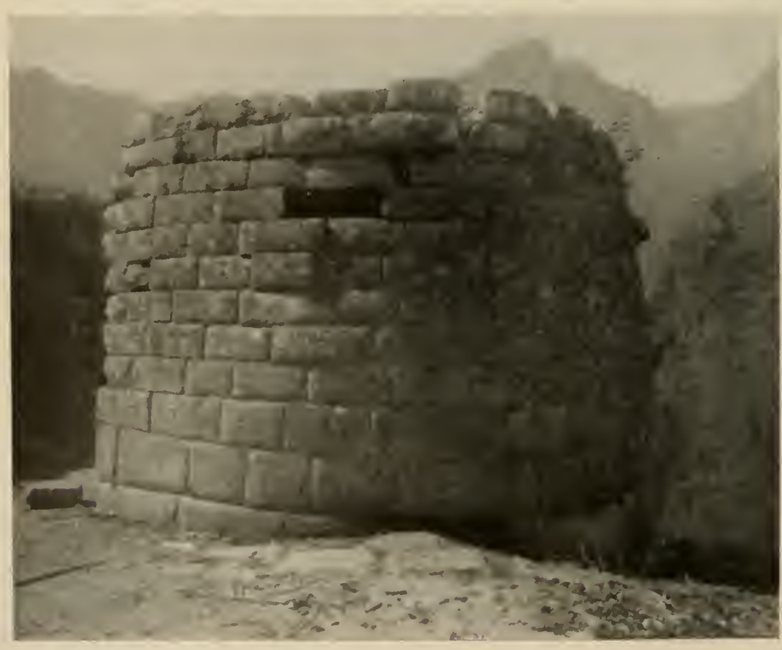


Aerial Explorations, Inc.

Half Hidden by Vegetation

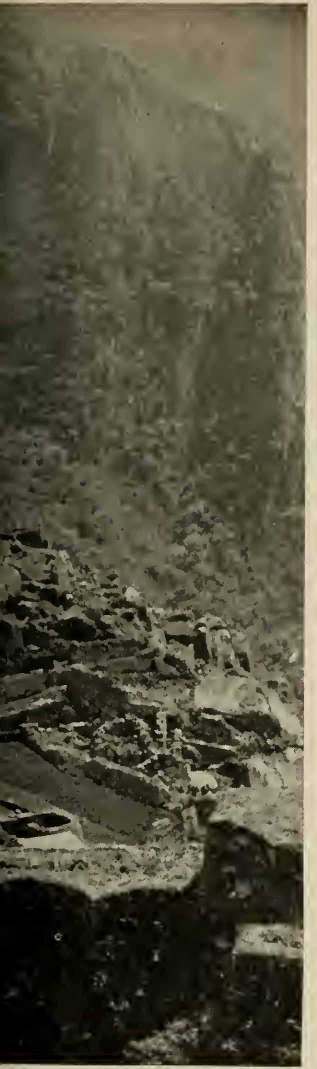
Just twenty years after the ruins of Machu Picchu were first exposed to the light by Dr. Hiram Bingham, the heavy underbrush had again almost covered them over. This aërial view taken two years ago shows the naturally protected ridge site of the fortified town





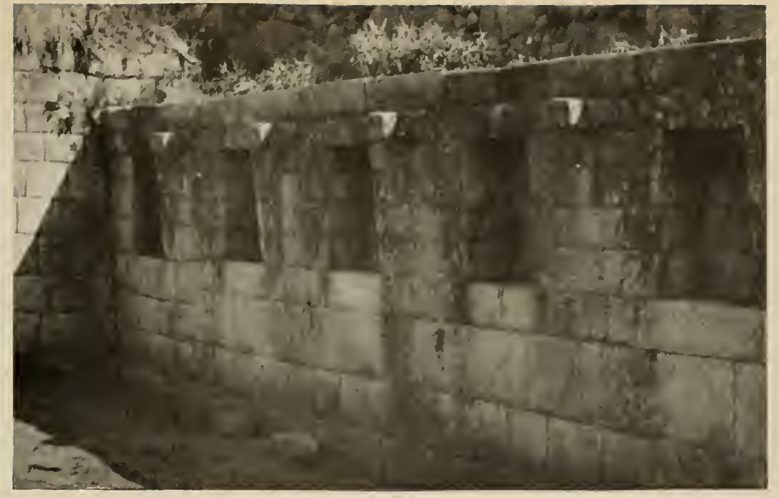
The Village

A semicircular temple in which the stone blocks are cut, dressed, and fitted into a curved wall is shown at the left. This is one of the rare features of the Machu Picchu ruin



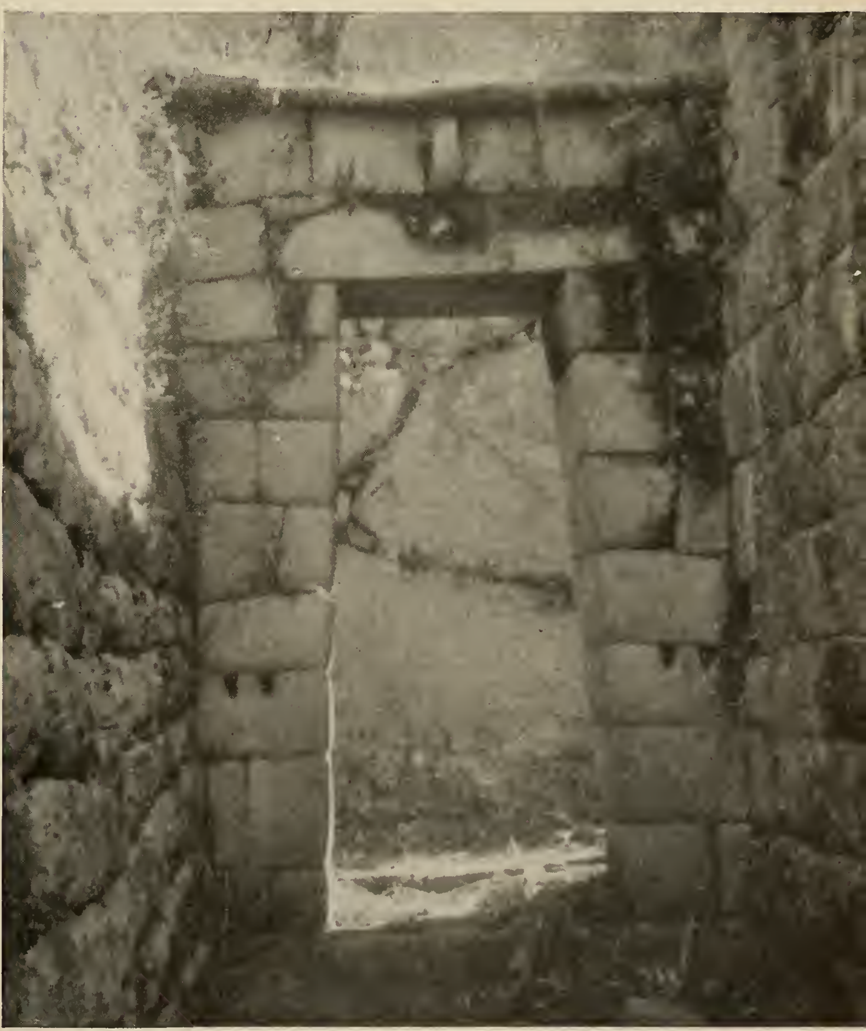
Recleared

Above is a view of the ruins almost the same as the air picture on page 65, showing the complexity of walls and terraces revealed when the brush is cleared away



Below: A doorway with the inset ring stone above, and the cut-out pegs at the side to which a plank door might have been fastened

Above: Typical Machu Picchu wall of cut stone with inset decorative niches and projecting stone cylinders



exception to the majority. Machu Picchu, if known to the early Spaniards, was never mentioned in their writings nor ever visited, all of which seems an oddity for so elaborate a ruin. The Indians living in the Urubamba region were no doubt familiar with the walls hidden by the heavy underbrush on that high ridge. However, in spite of such obscure scattered alternatives, it can be stated in all justice that the ruins of Machu Picchu were first discovered by Dr. Hiram Bingham in the year 1911.

A Hidden Village Discovered

There are several factors that help explain why the ruins of Machu Picchu were overlooked until so recent a date. First, the Urubamba river valley is not favorable for travel. It is a deep gorge, narrowing to bottle-neck passages, with steep sides and practically no regular trails. The well-protected valley is semitropical in climate and even today supports a luxuriant undergrowth. The ruin is located on the ridge, and was formerly so covered with brush that no one suspected its presence. Furthermore, the Spaniards had a much better route into the interior by way of the pass of Panticalla, according to Doctor Valcarcel, by which they were able to transport the coca leaf for trading with the Indians, and metals from the rich Vilcabamba mines. Finally, it is quite possible that the Indians were reticent about giving information as to the whereabouts of this once famous citadel.

The story of the discovery of Machu Picchu has been told by Doctor Bingham in the various reports of the Yale University—National Geographic Society expeditions. (*Machu Picchu,* Yale Press, New Haven, 1930, and "In the Wonderland of Peru," *National Geographic Magazine,* XXIV, No. 4, April, 1913.)

His exploration survey trip in 1911 went north from Cuzco into the Urubamba valley. The ruins of Ollantaytambo were examined and the trip continued. Six days' journey from Cuzco, an Indian resident volunteered to lead Doctor Bingham to a ridge below the peak called Machu Picchu. The trip ascending the steep valley sides was arduous because there were no regular trails. Arriving at the summit, he could see the elaborate cut stone walls through the heavy underbrush which covered them. Preliminary examination and clearing of brush on this first trip of discovery were enough to convince Doctor Bingham of the importance of his find. A year later, in 1912, he returned for his extensive examination of the ruins. His work consisted largely of the terrific task of clearing off the underbrush. However, extensive excavation was also carried on. His plans and photographs are well known.

Machu Picchu is one of the few ruins at which the destruction by the hand of man was at a minimum. True, Indian treasure hunters had rifled some of the graves, but, on the whole, the plant life was the only active destroyer. For the first time a scientist was virtually the original excavator and describer. Here was an Inca village, still intact. Contrast this with the capital city of Cuzco, where Inca foundations support colonial Spanish buildings, where Inca coursed stone walls are completely plastered over; where, furthermore, continuous habitation makes destruction a perpetual element and creates obstacles for excavation and reconstruction.

An Inca Site

Machu Picchu was also important in presenting a unit type culture. While evidences of two periods are not lacking, the bulk of the material is typical of the Inca period, be it in masonry, pottery, or small artifacts. This situation, for example, is entirely reversed in the relatively near-by ruin of Ollantaytambo, where a great slab stone wall of pre-Inca (Tiahuanaco) style, is connected to a wall of Inca cut stone and backed by a late Inca or post-Spanish adobe construction. Although Machu Picchu was probably occupied for considerable time, no great changes in style are observable and the whole can be taken as a classic example of Inca culture at its height.

The ruins are located on a hog-back ridge between two peaks. The larger peak is called Machu Picchu, the "old peak," and the smaller is called Huaina Picchu, the "young peak." No name for the actual ruins is known. When Doctor Bingham first ascended the ridge, he virtually cut his own trail for the two-thousand-foot climb. After the ruins were cleared, a trail was made up the southern slope which was a never-ending zigzag. Last year the Peruvians straightened the trail and improved the grading so that today the ascent is easier. Two years ago I climbed to Machu Picchu on the old zigzag trail. My Peruvian guide talked while I panted. He said they had been considering a cable railway to aid the tourist, but that he was against the idea because he felt that the climb augmented the appreciation of the ruins. This was certainly true. After that climb one does appreciate the extensive worked stone constructions. In the old days there was probably a road, traces of which remain along the high ridges, and which quite possibly was part of the extensive communication system running out of Cuzco.

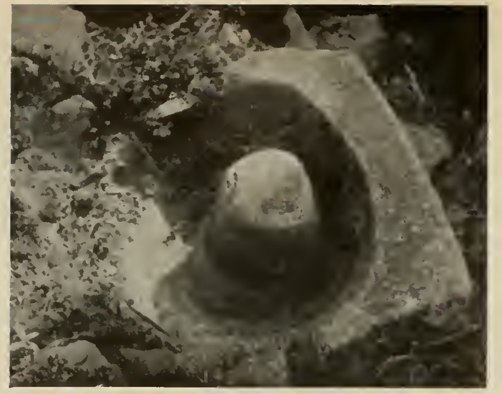
Machu Picchu site commands an excellent view of the Urubamba valley to the north and to the south. Investigation in the valley has shown that at one time it supported a large population. Agricultural terraces, aqueducts, house sites, village sites, and fortifications are common in the valley. In the Indian days, as at present, the lowland country was valued for coca (the narcotic leaf that the Indian is always chewing), chile pepper, cotton, as well as for the variety of fruits. It was not only for the products, however, that this section was so well protected. Fear of invasion from the interior undoubtedly stimulated the building of forts in various parts of this valley.

A Fortification

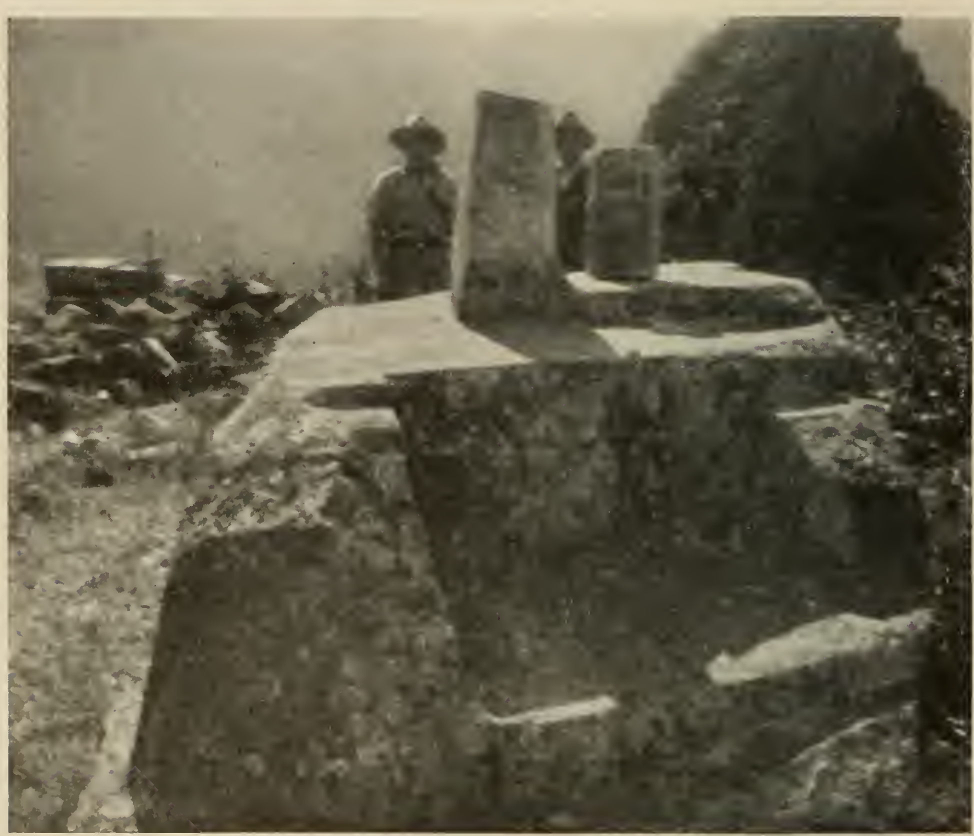
Machu Picchu was essentially a fortified village. The first impression of the site is that of a mass of terraces and buildings, completely covering the ridge, and all built of well dressed stone blocks. More thorough examination reveals the defense features. The north side of the ridge is practically impregnable because of the steep slopes and sheer drops. Nevertheless, wherever possible, stone walls were built to augment the already precipitous slope. Two outer defense walls were built along the surrounding ridges, and to the south of the ruins. These were constructed of cut stone, and carefully aligned to enhance the naturally defensible contours of the ridges. On high points about the ruins were signal stations where observers sat watching for possible dangers. Even on the summit of the peak Huaina Picchu was a carefully constructed watch platform, 4000 feet above the valley. The slope on the south side of the ruins is less precipitous. Here agricultural terraces, stone faced and about eight feet high, formed a defense unit. Around the village ran an inner defense wall from fifteen to twenty feet high, and outside of this was a dry moat. The village itself was made of groups of houses, with their outer walls of solid stone.

Houses and Temples

The ruins very logically can be described in units. Some were temples, some houses. Some are on one level, some on another. The houses are divided by narrow passage ways. Every available place in the village, not occupied by houses, has agricultural terraces. Various levels, houses, and terraces are connected by stairways. Three groups are distinguished by their workmanship and position and considered as principal residences. The only frequent travelers in the Inca society were chiefs and messengers. Along every important trade route or roadway were resting places for food and lodging called *tambos* (or *tampus*). The important *tambos* had special residences maintained for distinguished chiefs. The "Palace" unit at Machu Picchu is probably one of these residences. It consists of two large rooms and two small chambers, all built around a central patio.

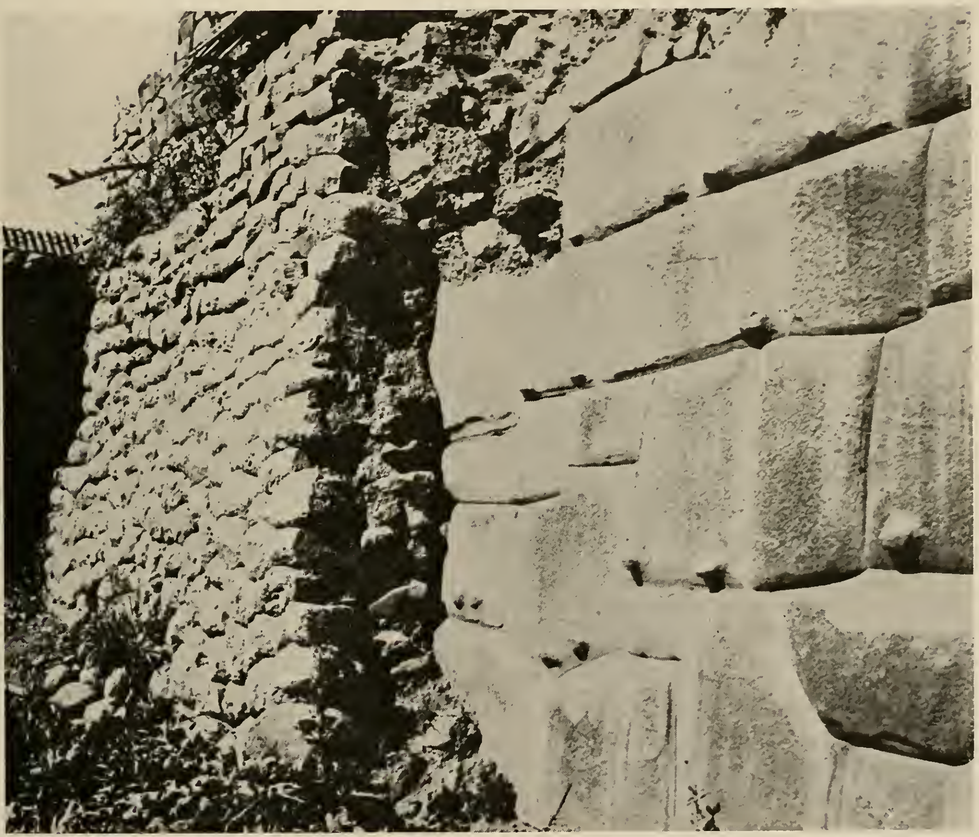


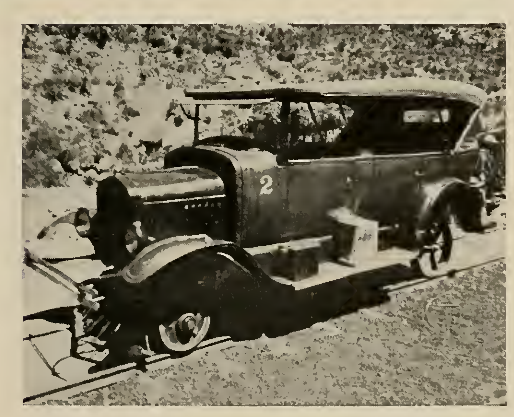
Base of a door "lock" over which was placed a slightly hollowed stone. The inset peg thus formed was built into the side wall of the doorway as a binding post for the door beam



Above: The *intihuatana* or sundial by which the seasons were accurately calculated. (*Right*): Drilled window ledge which Doctor Bingham associated with a temple for snake worship

Large natural rocks within the house walls were skillfully cut and utilized. The set shown at the right served as practical grindstones. This pair is the finest at Machu Picchu





Above: A cut stone wall in Cuzco overlain with a rough stone wall, which illustrates a technique and a confusion not found at Machu Picchu. (*Left:*) Modern transportation from Cuzco to Machu Picchu

Several units in the ruins can be considered as sacred places or temples. The main temple is located, roughly, about the center of the ruins, in what Doctor Bingham calls the Sacred Plaza. This temple or gallery had only three walls, that is to say, it was always open at one end. At the walled end at the back was a large block which probably served as the altar. Above this in the wall are seven inset niches between which are projecting stone cylinders. The side walls of this temple use massive blocks of stone in the construction. One stone measured thirteen and one half feet long and eight feet high. Even this large stone was carefully fitted with the small blocks above it.

Another temple is noteworthy because of three windows in a row, all with stone lintels. Since windows are rare in Inca construction, these are particularly interesting. A third temple group has the unique feature of a semicircular tower. This curved wall is made of blocks of carefully dressed and fitted stones. The wall curves into a horseshoe shape. Another such curved wall is found in the "Temple of the Sun" in the Dominican monastery at Cuzco, but their occurrence is decidedly rare. Connected with this semicircular tower is a plain, straight-walled room. In the curved wall are six inset niches and two windows, and in the straight walls are twelve inset niches. This temple shows no evidence of ever having been roofed over. Below this last unit, which stands on an outcropping natural rock, is a large cave, carefully carved with deep niches and benches. It has been considered the most likely place for interring the important dead.

The Sundial

Located on a cleared rock formation is a large stone, cut flat on top with a projecting prism from the center. This was the "*intihuatana*" or sundial. Once this was carefully marked so that the shadow of the prism on the flat rock indicated the solstices and equinoxes. In an agricultural community calendrical knowledge is of great importance. Many of these sundials have been found in Inca ruins.

All the Machu Picchu houses are built of stone with thatched roofs, and two-story houses are found, which is quite uncommon. The end walls of the house are built up to a triangular peak which forms the central gable. Projecting pegs alternate with inset ring stones for attaching the beams of the roof to which the thatch was fastened. This function for the stone cylindrical pegs on the roof section has been clearly demonstrated by Doctor Bingham, but the projecting pegs between the niches on the inner temple walls are more of a mystery. Doctor Valcarcel suggests that they might have been used for hanging the various *quipus*, or knotted string records.

Features of House Construction

The houses were decorated with inset niches on the inside, and many of them have windows. Most of the doorways are narrower at the top than at the base, a typical Inca style, and all have single stone lintels. The actual doors were probably made of split logs, tied together. Above many doors is an inset ring stone, and at the side is a cut-out peg, topped with another stone, which is usually called a lock. Doctor Bingham demonstrated one probable method of fastening the doors by means of a vertical log attached to the ring at the top, and a cross beam, tied to the side peg. Natural rocks within the house were cut and utilized rather than removed. Thus one set of natural rocks served as large grindstones.

Each group of houses has distinctive characteristics. Doctor Bingham describes one group which had a red clay plaster on the inner walls. Another had a group of terraces and gardens within the private house patio. Still another was featured with monolithic door lintels.

Most of the stone walls of houses and terraces show remarkably fine technique of manufacture. The stones are of medium-sized, well-cut blocks, laid in roughly horizontal lines. The masonry is not coursed, but projections from one block fit into notches in another, thus forming a solid jointing. No plaster or cement of any kind was used.

Machu Picchu has been described as a city of stairways. The whole complex system of terraces, temples, and houses, running along an irregular and steep-sided ridge, is tied together with innumerable stairs. Three thousand steps were counted by one patient observer. Some of the steps are regular series of individual cut stone blocks. Some are more irregular, utilizing natural rocks and cut-out ledges. One set is monolithic, in that steps and sides are cut from one great rock.

The Water Supply

Water was conducted through small stone aqueducts from springs on the mountainsides, some at considerable distance. Once entering the ruins, the water was allowed to run over terraces and down steps. Eventually it ran into stone cut reservoirs, commonly called "baths." Water must have been a great problem at all times, because the aqueducts are small, and because many of the springs disappear during the dry seasons.

Although some of the more prominent personages possibly were entombed in important caves at the village, such as the one under the semicircular tower, most of the burials were found in caves on the slopes below the village. Excavation of these caves revealed bones in bad condition, and, buried with them, bowls and tools. The skeletons in better condition showed that the individual had been buried in a sitting position with the knees raised. Some of the skulls were artificially deformed, in accordance with Inca custom.

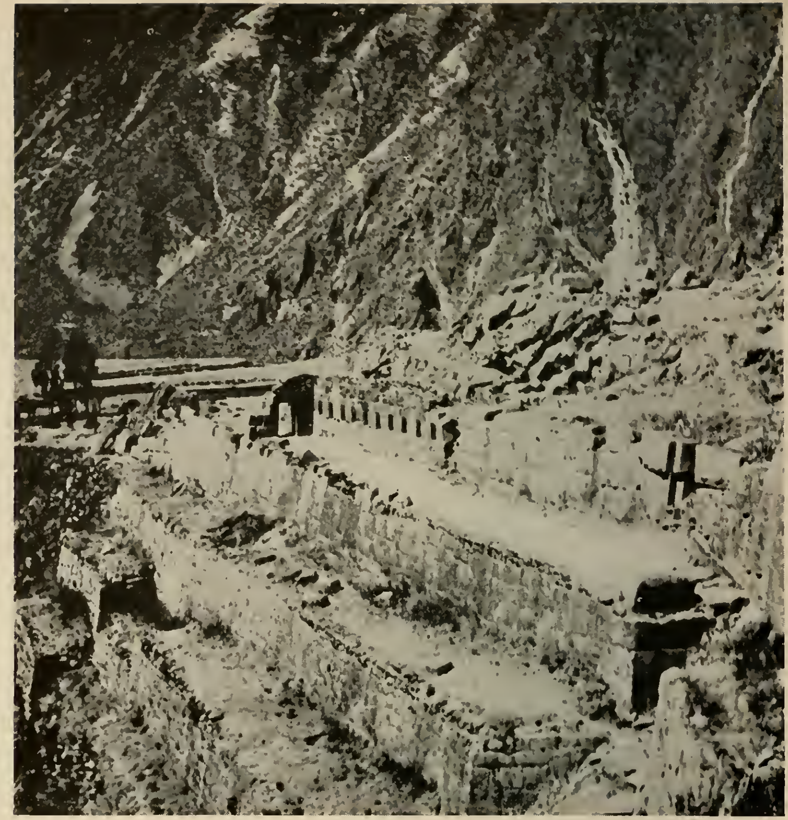
The discovery and description of this elaborate ruin immediately raised the question of the builders. Doctor Bingham in his researches came to the conclusion that the city was built by the old Tampu Tocco peoples as a city of refuge during the troublesome early years, and that later these same people returned to Cuzco and founded the Inca Empire. The traditional basis for this story was taken largely from the account of Fernando Montesinos, an ecclesiastical lawyer who first came to Peru in 1629. The gist of the legend is that Pachacuti VI, 62nd chief (Amauta) of the early inhabitants, went with the scattered remains of his people to a place called Tampu Tocco, where he built a city of refuge against the serious attacks of the invading hordes. There they lived in a city where there was a large cave for preserving the remains of the ancestors, and houses with windows. After some five hundred years they again grew powerful, returned to Cuzco, and started the later Inca Empire. Traditionally the site of Paccari-tampu near Cuzco has been considered the town where Pachacuti VI led his people. But, as Doctor Bingham points out, neither cave nor windowed houses are found there, while both exist at Machu Picchu. This, plus the excellent isolated and impregnable position of the latter ruins, is the principal basis of his identification.

That a highland civilization of megalithic temple builders existed in Pre-Inca days is undisputed. The stone-pillared temples of Tiahuanaco in Bolivia, the base walls of gigantic stones in Sacsahuaman fortress near Cuzco, the red sandstone slabs of Ollantaytambo, all are remnants of this period. The stone building civilization extended into northern Peru and Ecuador as well. However, the identification of Machu Picchu with this period is more difficult. In spite of the use of large stones in some parts of the ruins, the techniques which distinguish ruins of the earlier types are not found.

All Materials Typical

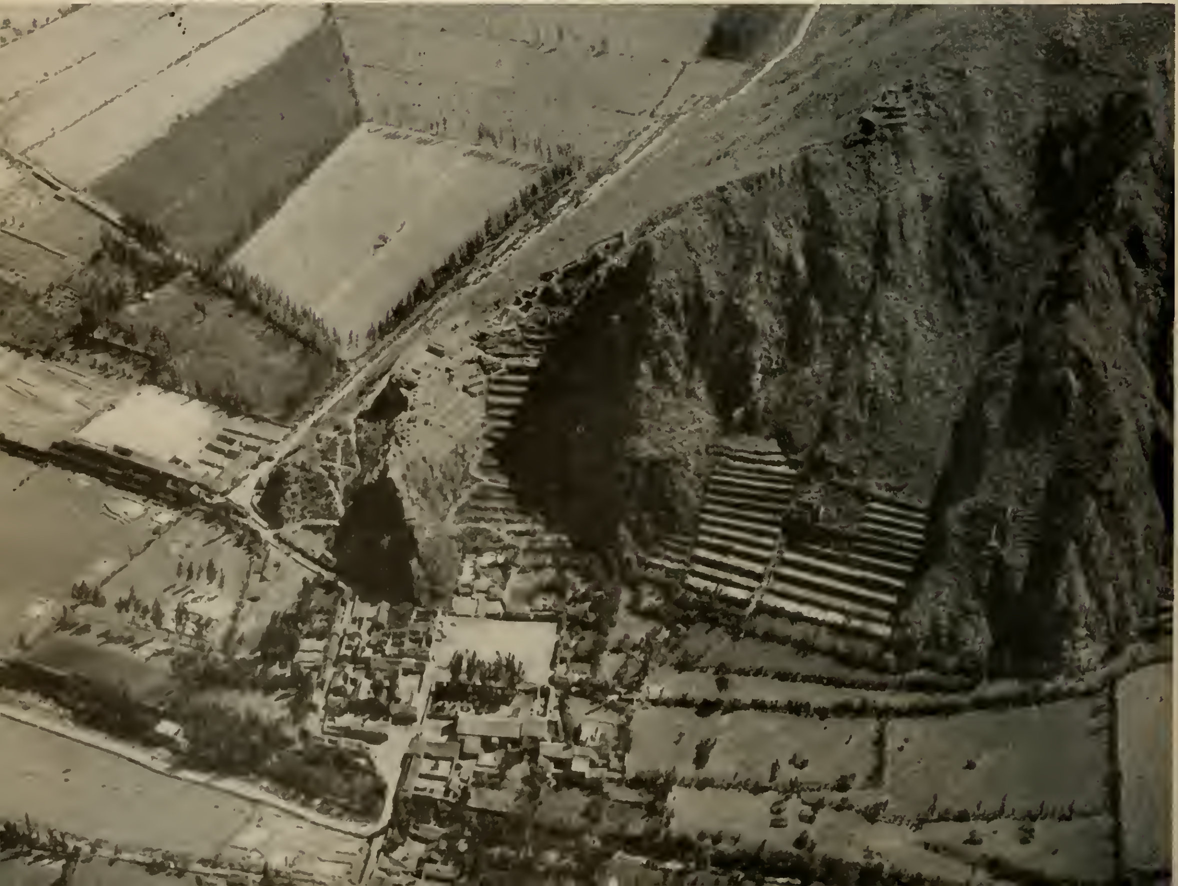
Pottery and tools found at Machu Picchu are clearly Inca in style, practically without exception, although Doctor Bingham does describe certain small stone counters, and "record" stones in the shapes of animals, which are not universally found with Inca associations. The so-called ashlar masonry technique is typically Incan and is found in many other sites. Most recently it has been

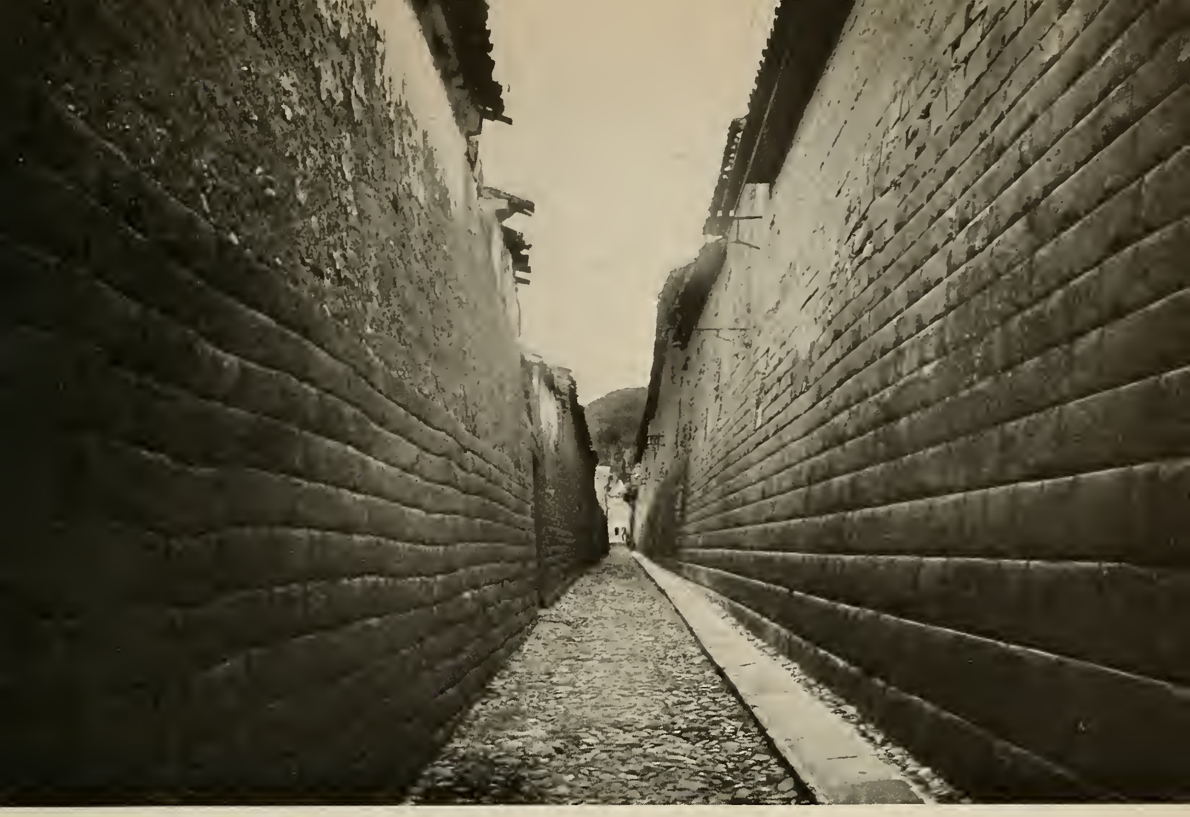
Cut stone terraces of Ollantaytambo ruin. The top wall has the inset decorative niches and a doorway in Machu Picchu style

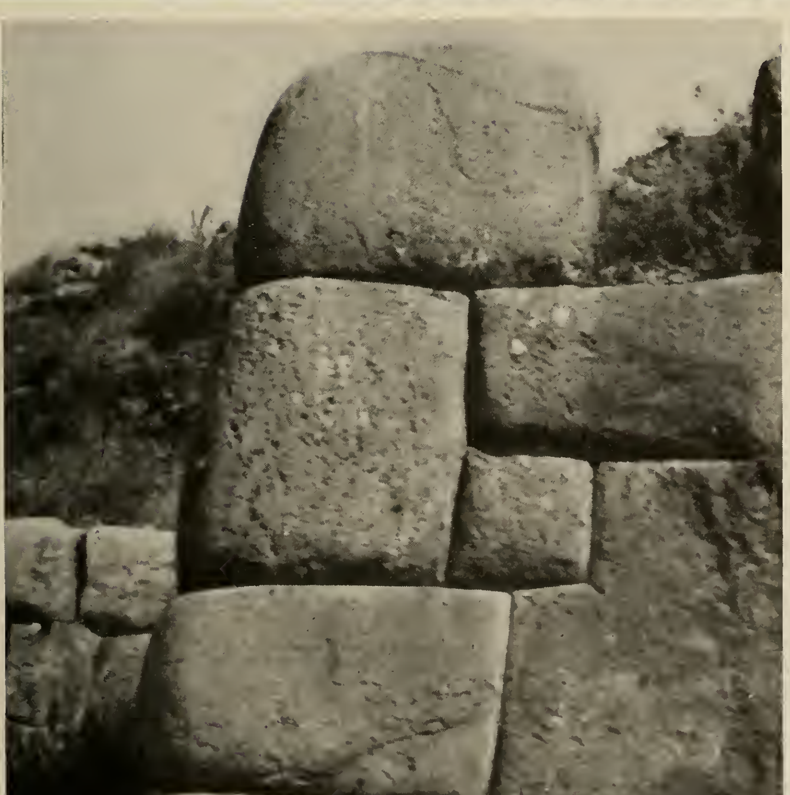


An air view of Ollantaytambo village and ruins, not far up the valley from Machu Picchu. The modern village covers the site of the ancient one. The valley around this site holds many indications of the Inca civilization, such as elaborately cut rock formations, "baths," canals, and many terraces like those illustrated

Aerial Explorations, Inc.







A street in the town of Cuzco, flanked on both sides with Inca cut stone walls. Modern adobe walls are built on the ancient ones. This confusion of old and modern does not exist at Machu Picchu which remained isolated from all contacts until its discovery twenty-three years ago

Corner section of the base wall of Sacsahuaman fortress near Cuzco. Recent excavations of the Peruvian government have disclosed Machu Picchu walls as part of the interior structure of this ruin. The fortification walls, with their irregular but carefully fitted stones, indicate an older cultural strata found as part of the inner structure of Sacsahuaman fortress. Even the excavation at Machu Picchu showed no great depth of culture. However, certain local peculiarities can be noted for the Machu Picchu ruins. The cylindrical projections of stone in the walls; two-story houses; many windows; abundance of stairways and terraces; open buildings; and three-sided temples open at one end, are all indicative, according to Doctor Valcarcel, of influence from the earlier period. However, the ruin of Ollantaytambo, not far away in the same valley, has definite sections which conform to the early period, and it is possible to account for some of the features of Machu Picchu through the influence of this site.

Ollantaytambo did not share the fortune of Machu Picchu in remaining undiscovered until recent times. It is still a pueblo with inhabitants who find it easier to collect than to cut building stone. This has been going on for years, and much of the ruins has been disturbed. Still it is one of the most interesting sites in the whole Cuzco region, because it presents evidence of several cultural periods.

The megalithic red sandstone wall of well cut and fitted blocks is in contrast to the style of the rest of the ruins. Six blocks form this wall. The average size of a block is about from five to six feet wide, more than twelve feet high, and about five feet thick. Thin, well fitted pieces of cut stone are inserted between these blocks to form the finished wall. Other walls and terraces near this are also made of large, dressed sandstone blocks. One block is cut into a set of steps. Some of the blocks have T-shaped grooves for joining with copper cramps. All work of this kind is suggestive of the early megalithic highland period.

Backing the megalithic wall is another of small fitted stones in typical Inca style. Along one side is a series of terraces constructed of dressed stone blocks, typical of the Machu Picchu style. The top wall of this terrace has inset niches and a large doorway with a stone lintel. Besides the well cut stone terraces there are others of rough stone, probably of more recent construction. Recent work by the Peruvians at Ollantaytambo has furnished some evidence of stratification in these various building techniques. Their digging on the hill has exposed a small section of a wall of a building, of oblong, well squared blocks with polished surfaces, beneath the floor of a building which is of the later, rough stone, Inca style. Also, they have discovered stairways connecting the various terraces, and still deeper in the excavation, other stairways which apparently run under some of the present terraces, and thus represent an earlier period.

On the ridges above the ruins and in the valley below are many houses and walls of the rough stone and adobe type. Yellow paint finish is found on the inner walls. All through the valley are traces of Inca occupation. A cliff of outcropping stone is elaborately cut with niches, benches, and trails. Several "baths" are found cut out of solid stones, as part of a complex system of small canals.

Ollantaytambo obviously represents a site of long habitation through several changes of culture. Some day excavations should uncover a series of pottery types in a stratified refuse deposit. Pottery with shapes and designs of the early highland period has not yet been found in the Cuzco region. Such a discovery would be of great importance in the archæological problem.

The Machu Picchu Jewel

The Peruvian government is doing important work on this problem, and perhaps when the results of their labors are studied and published, the chronology of Archæology will be more fully understood. The work at Machu Picchu has been mainly one of clean-up and preservation. Still, it is interesting to read the opinion of Doctor Valcarcel, director of all the recent investigations; "Archæologically and artistically, Machu Picchu is today the most valuable gem of pre-Columbian American culture."

The Ellsworth Antarctic Expedition

The difficulties and delays that have beset Lincoln Ellsworth in his present attempt to cross the South Polar Continent

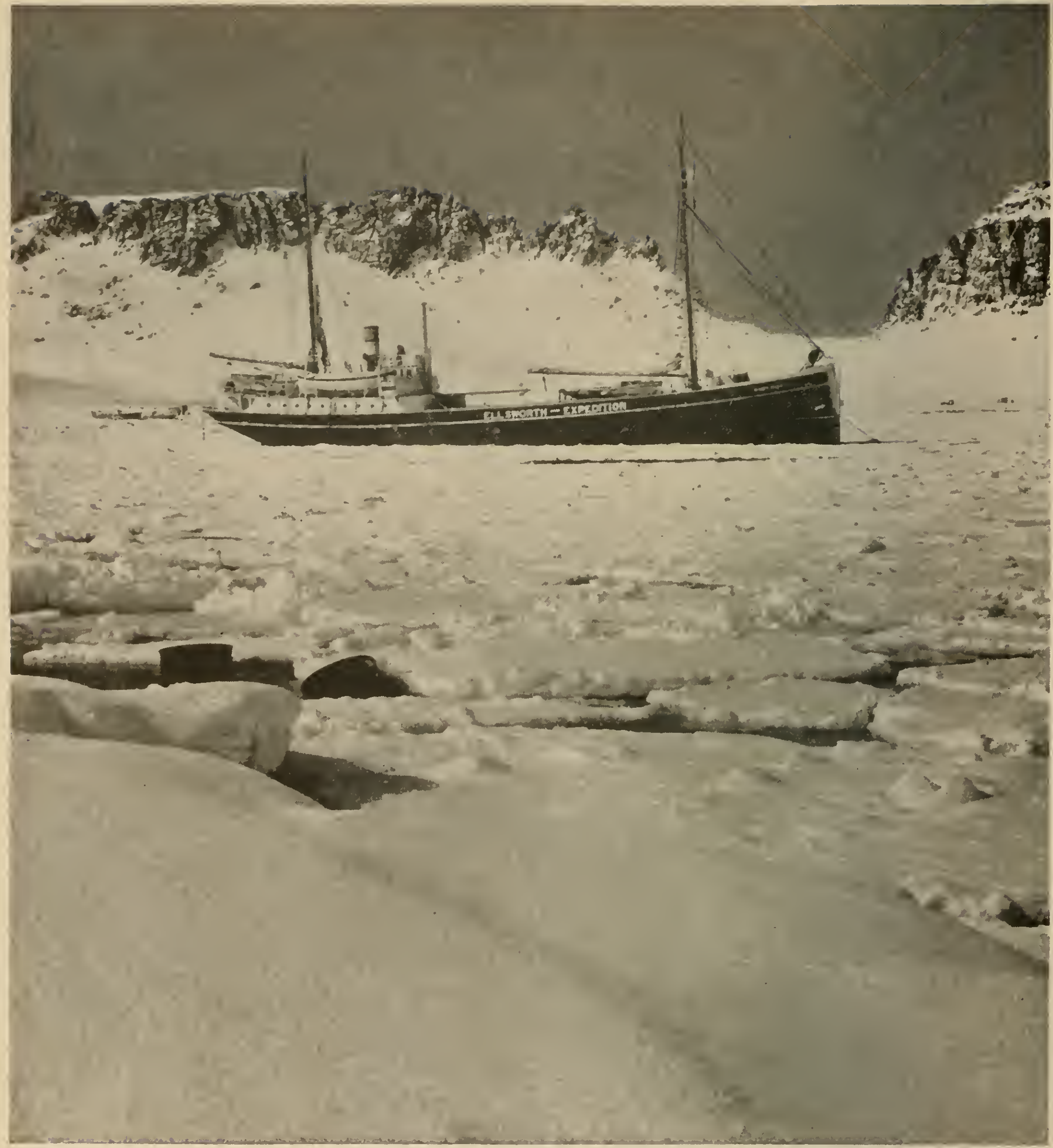
© N.A.N.A.

Lincoln Ellsworth, trustee of the American Museum and leader of the Ellsworth Antarctic Expedition, at the bow of the "Wyatt Earp"

BY the time this issue of NATURAL HISTORY reaches its readers, the newspapers undoubtedly will have published further accounts of the activities of the Ellsworth Antarctic Expedition. It is probable that the transantarctic flight will have been begun, and perhaps completed, with the result that another section of the great white continent will have been subtracted from the shrinking area of the unknown. As this article is being written, however, the expedition is awaiting improved weather conditions, in order that the preliminary test flights may be made before attempting the 2700-mile flight from Snow Hill Island, in Weddell Sea, across the Antarctic to the edge of the Ross shelf ice beside the Bay of Whales.

Reports from the expedition, sent by radio from Deception Island and, more recently, from Snow Hill Island, tell again of the difficulties that face the Antarctic explorer on this side of the great Antarctic continent. Where the Ellsworth Expedition's attempt of last year to fly from the Bay of Whales across Antarctica and back was brought to an untimely conclusion by the abrupt breaking up of the ice with consequent damage to the plane, the new attempt has been repeatedly balked, first by the bending of a connecting rod in the powerful motor of the plane, second by the melting of the snow on Deception Island making it impossible to take off, and third, by the snowstorms and other adverse weather conditions that have been almost continuous since the expedition transferred its activities to Snow Hill Island a hundred or more miles farther south.

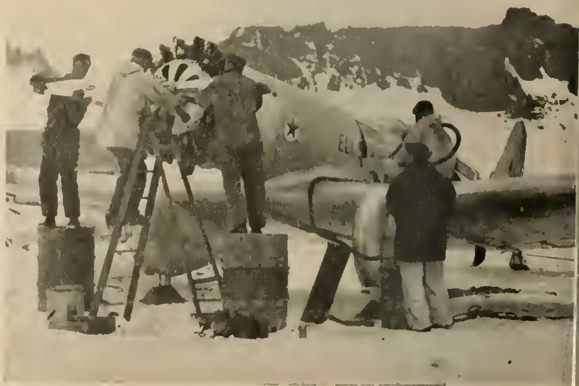
As a result of the experience gained during the 1933–34 expedition, Deception Island was decided upon as this expedition's base. This plan, as Mr. Ellsworth explained in an article in the July-August, 1934, issue of NATURAL HISTORY, accomplished two things. First, it reduced by a hundred miles, or thereabouts, the distance the plane would have to fly, and at the same time increased by about 1300 miles the amount of unknown territory to be crossed by the flight. Where, in other words, a "round trip" flight of 2900 miles would have been made according to the 1933–34 plans, covering 1450 miles from the Bay of Whales to the head of Weddell Sea



© N. A. N. A.

At Deception Island

Above is shown the "Wyatt Earp" which carried the Ellsworth Expedition to southern waters both for the 1933-34 expedition and for the current one. At the right, members of the party are fitting the plane with its propeller. The lack of a suitable runway from which to take off with this one-and-a-half-ton machine greatly delayed the expedition's work. These two pictures were received in New York in December, 1934



© N. A. N. A

North Graham Land

One of the numerous desolate islands of Antarctica. In the contemplated flight almost 2800 miles of these snowy wastes will be crossed

© *International News Photo*

Cliffs of Ice

A scene at Deception Island from which point the Ellsworth plane was to take off on the trans-antarctic flight. Rapidly melting snows on the island's only available runway, however, prevented this

© *International News Photo*

and the same distance back over the same route, the 1934–35 plans call for a flight of some 1300 miles from Snow Hill Island, to which the expedition has now moved from Deception Island, to the head of Weddell Sea, and in addition the 1450 miles from Weddell Sea to the Bay of Whales.

With Lincoln Ellsworth, Sir Hubert Wilkins, and Bernt Balchen as the principal figures in the expedition, it is obvious that every contingency will be met by men widely experienced in such difficult work. It is obvious, too, that if delays have occurred, it is because conditions in the far south, and especially in the Weddell Sea area, are extraordinarily difficult. As a matter of fact, the history of the exploration of Weddell Sea is replete with accounts of extraordinary adventure and heroism. The story of the Shackleton Expedition of 1914–16, which attempted to cross the Antarctic continent, is, perhaps, the outstanding story of heroism and difficulty in these frozen regions. Caught in the ice of Weddell Sea, where she was held prisoner for ten months before being crushed and sunk, the Shackleton ship "Endurance" played no small part in this amazing adventure. Left with only their small boats and with such supplies as they had salvaged from the wrecked vessel, the crew, under Shackleton's indomitable leadership, eventually reached Elephant Island, from which Shackleton himself, with five companions, set sail in a twenty-foot boat at the beginning of the Antarctic winter in an attempt to reach South Georgia where help could be enlisted in an effort to save the main body of the expedition who were left behind.

Having, after one of the most extraordinary small boat voyages ever made in the history of the sea, reached South Georgia—having, in addition, with one of his five companions, actually succeeded in crossing the island's almost impassable mountains, this amazing leader was able to rescue his marooned expedition only after three desperate attempts had failed.

Antarctic exploration has progressed far since Shackleton made his gallant but ill-fated attempt, but not from that day to this has any effort to cross the Antarctic continent succeeded. Few explorers would care to face the hazards and the toil that such an undertaking requires, but Lincoln Ellsworth, who with Amundsen flew from Spitzbergen across the North Pole to Alaska, is now making his second attempt at just such a crossing. It is true that airplanes have come to take the place of dog teams and other simple equipment. It is true that a flight such as Ellsworth and Balchen are now about to attempt could succeed in fewer hours than Shackleton would have spent weeks. Yet the vast ice fields of the glacier-covered continent of the far south offer difficulties that exist nowhere else on earth, and even the improved equipment of the explorer of today gives him only a little advantage over the explorers of Shackleton's time. Difficulties such as rarely have to be faced by explorers elsewhere on the earth's surface are forever to be guarded against by the expedition that dares approach the icy Antarctic continent on its Weddell Sea side, and any success that is attained by those who attempt this most difficult of tasks, must, because of these very difficulties, bulk large in the sight of observant people.

Science in the Field and in the Laboratory

American Museum Activities,
Expeditions, Education,
Meetings of Societies,
and New Members

Edited by
A. Katherine Berger

An Expedition to Burma

Explorations to study animal and plant life in the upper parts of the Chindwin River—deep in the hinterland of northern Burma—are to be undertaken during the early part of 1935 by an American Museum of Natural History expedition headed by Arthur S. Vernay, field associate of the department of mammals of the Museum.

The country to be studied is close to the border of southern China and has never been explored. In fact, the only white visitors to that region have been a few government officials and scattered military patrols. The expedition will collect botanical specimens, mammals, birds, and insects, and will also photograph various types of natives such as Kachins, Chins, Karens, and others, in conjunction with anthropological studies.

The government of Burma has permitted the expedition to collect all kinds of specimens of scientific value. Mr. Vernay started for India on December 4. He was accompanied by Mr. Harry C. Raven, associate curator of comparative and human anatomy, of the Museum. The formal title of the expedition, one of the many sponsored by Mr. Vernay on behalf of the American Museum, is "The American Museum of Natural History-Vernay-Hopwood Chindwin Expedition."

The outfit will leave Rangoon on January 8, where Mr. Vernay and Mr. Raven will be joined by S. F. Hopwood, chief conservator of forests for the Indian Government, and three members of the Bombay Natural History Society. After a rail journey which will end somewhere north of Mandalay, the expedition will push into the interior. It will be slow and strenuous going, even with the aid of some twenty natives and more than one hundred shan mules.

The expedition expects to be in the field about three months, and is not going to look for any one particular thing, excepting perhaps a new subspecies of tsine, an extremely interesting wild cattle of Burma. The expedition will be equipped to collect and to carry a large number of specimens. More than eighteen months were spent in preparation. The Bombay Natural History Society has given splendid coöperation, and the members of the expedition are quite hopeful that a number of entirely new types will be discovered.

The Sage West China Expedition

Word from the field received from Assistant Curator T. D. Carter, under date of September 28, indicated that the Sage West China Expedition was at last on the collecting grounds and work was well under way. On that date the party was encamped in the Chen Lliang Shan Range about 30 miles west of Wenchwan, at an altitude of 10,000 feet, well above timber line. Dense fog was hampering the hunting very badly, but on one clear day three blue sheep were secured. The fog, however, had not interfered with the trapping of small mammals, which in three days had yielded 63 skins.

Canadian Wood Buffalo

The Snyder Canadian Expedition for Wood Buffalo and Small Mammals, comprising Harry Snyder, leader, and George G. Goodwin, American Museum representative, returned to New York City on October 15, after having secured for the Museum 4 wood buffalo, 1 stone sheep, and 180 small mammals.

The wood buffalo were never very plentiful in the more recent times; the introduction of large numbers of plains bison, from the Wainright herd, into Wood Buffalo Park, has resulted in cross breeding and rapidly diminishing numbers of true wood buffalo. The group secured by the expedition will probably be the last to come out of the reservation that can positively be recognized as the typical specimens.

Mr. Goodwin left New York City on June 30 and arrived at Dawson Creek on July 6, then traveled up the Peace River seventy miles by boat to Hudson Hope, then, by pack train, four days' journey to Halfway River. After collecting here for three weeks he returned to Edmonton and left, by plane, on August 8, for Wood Buffalo Park, and was joined by Mr. Harry Synder on August 13, at Pine Lake, summer range of the buffalo.

The first day on the buffalo trail the party met a Wainright bull, which charged through the middle of the outfit; later, they encountered many solitary old bulls and herds of 20 or 30 animals. Unfortunately, none of these were wood buffalo with the exception of one enormous specimen which was collected, measuring over six feet high at the shoulders. The buffalo, at the time, were in the thick forest, driven there by bull-dog flies, which hang about in swarms. The animals do a great deal of rubbing and seemingly take especial pleasure in rooting out and tearing to shreds small spruce and pine trees. The rutting season was at its height, and, maddened by flies, the animals were extremely dangerous to hunt; furthermore, it was difficult to select suitable specimens in the heavy forest. The expedition decided to continue on its trip north and return in the latter part of September to secure the remainder of the group, when the animals would be in more open country.

Leaving Pine Lake, Wood Buffalo Park, on August 19, the party traveled north to Fitzgerald on the Slave River and then to Resolution on the Great Slave Lake; down the Mackenzie River to Fort Simpson, and on to the forks of the Nahanni and Liard rivers. From here they flew to the head waters of the Nahanni River in the high peaks of the Mackenzie Mountains, to get information on the reported black-tailed sheep. Though, from the air, sheep were seen on the mountain ridges, there was no landing place for the plane within 200 miles, but sufficient information was gathered to assure a successful trip here next year.

The next flight was to Fort Nelson and then northeast to Dorothy Lake, 400 feet elevation in the mountains. Here the men were fortunate enough to observe a herd of elk and also saw grizzly bear, small bands of caribou, and numbers of moose. Traveling by pack train, the expedition crossed the Muskwa and Prophet rivers and over the Caribou Range in a snowstorm, eventually arriving at Deadmans Lake, where the plane met them, and after a delay of three days, due to weather conditions, they returned to Wood Buffalo Park to complete the group. The buffalo were now moving to their winter range in more open country, and the party was fortunate to find a small herd of true wood buffalo, including cows and calves, on the salt plains.

Ellsworth in Antarctica

Lincoln Ellsworth's dispatch of December 2 from Snow Hill Island, Antarctica, (New York *Times*, December 3) calls attention to the 1901–03 work of the Nordenskjold expedition on Seymour and Snow Hill islands. He relates that Dr. J. G. Andersson and Lieut. S. A. Duse, of that expedition, are supposed to have left a hut and valuable collections of fossil plants and other fossils on Snow Hill Island. Volume III (1916) of the publications of the Nordenskjold expedition, contains reports on the rich Mesozoic flora (Jurassic) found at Hope Bay, Graham Land, and of a mid-Tertiary flora from Seymour Island. These areas appear now at the margin of the great Antarctic ice sheet. During the Jurassic and mid-Tertiary times there were no near-by ice fields, for the land was then clothed with a rich temperate and subtropical vegetation. The list of Hope Bay Jurassic flora includes the following groups: Equisetales 1, Filicales 25, Cycadophyta 19, Coniferae 13, Gymnosperms 2. The ferns, cycads, and cone-bearing plants were thus well represented. The flora is correlated with the middle Jurassic flora of England and Europe and that of the upper Gondwanas of India. The Hope Bay plants constitute the first Mesozoic flora known from the Antarctic. This is of special interest in that the Mesozoic era is commonly known as the Age of Reptiles. One of its periods, the Jurassic, was characterized by the presence of huge dinosaurs, typified by *Brontosaurus* and *Diplodocus*, which fed upon the same sort of luxuriant vegetation in western North America and eastern Africa.

In this same volume Prof. Carl Winan describes the fossil remains of a large extinct whale, *Zeuglodon*, and various species of extinct penguins, all of which were collected by J. G. Andersson from the older Tertiary beds of Seymour island. These specimens indicate a climate somewhat like that which exists today on Antarctica. The next article by Dr. P. Dusen deals with a large mid-Tertiary flora from Seymour island. The plant list includes *Araucaria* and associated forms, which are more modern in aspect than the Jurassic flora from Hope Bay. They also indicate a much warmer climate than the present Antarctic one. The *Araucaria* are abundant today on the well watered western slopes of the Andes Mountain of southern Chile.

The presence on the one hand of numerous fossil plants of Jurassic and mid-Tertiary age on Seymour, Snow Hill, and other islands of the Antarctic archipelago, and the finding, on the other hand, of early Tertiary remains of whales and penguins, which may be associated with frigid conditions similar to the present, suggest that the Antarctic continent during past geologic ages has been subjected to a successive alternation of warm and cold climates, each phase of which embraced a vast extent of time. A tremendous amount of data is being collected by geologists, which would tend to show that these climatic changes were world-wide in scope, that the variations were more marked in the Arctic and Antarctic regions, less so in the temperate zones, and least of all in the tropics.

Lincoln Ellsworth's dispatch from Snow Hill Island is thus of vast import. The data which the Ellsworth and Byrd expeditions are now accumulating in widely separated parts of Antarctica should add much to our knowledge of the geography and variable climates of that vast region.

—Chester A. Reeds.

THE HAYDEN PLANETARIUM DOME, AMERICAN MUSEUM

Finishing the outer dome of the Planetarium. Here the concrete is being applied with an Akeley Cement-gun. After this process is completed the dome will be covered with copper

Photograph by H. S. Rice

Astronomy

The attendance at the meetings of the Amateur Astronomers' Association has continued to be most encouraging during the fall. The average attendance is around two hundred, and the close attention to the lectures manifests the sustained popular interest in the study of astronomy.

On Tuesday, December 18, the Amateur Astronomers' Association gave the first of its 1934–35 series of radio talks over Station WOR from 4:15 to 4:30 P.M.

On December 19, Mr. Charles A. Federer, Jr., instructor of the advanced class of the Amateur Astronomers' Association, gave the first of his three talks on stellar diameters. On this occasion his subject was Luminosities and Temperatures; on January 2, it will be The Interferometer; on January 16, Giants and Dwarfs. All those interested are invited to attend this series of talks. The meetings of the Association are open to the public and visitors will be cordially welcomed.

Progress of the Hayden Planetarium

The building for the Hayden Planetarium is progressing rapidly. The outer dome is nearly completed with the exception of the copper covering. The application of the concrete with the Akeley Cement-gun has attracted much attention. Although this method was used in European planetariums, the dome of the Hayden Planetarium is the first one in America to be constructed in this way. An interesting coincidence is that the Akeley Cement-gun was photographed while in operation on the planetarium of the American Museum by an old friend of Carl Akeley, using an Akeley Camera.

Carl Zeiss, Inc., has promised to deliver the Projection Planetarium instrument before January 1, 1935, and J. W. Fecker has promised to have the Copernican Planetarium ready by March 1, 1935.

There is a possibility that the Planetarium may open as early as June 1, 1935.—CLYDE FISHER.

American Museum Guests

The American Museum is favored from time to time by visiting scientists from other countries who come to study its great and rapidly growing collections. The department of vertebrate palæontology has at present as a guest scientist Dr. L. D. Boonstra, who comes from the South African Museum in Cape Town, to study, especially, the American Museum collection of primitive South African reptiles known as the Broom Collection. Doctor Boonstra is making a thorough restudy and revision of this collection and has already prepared several papers on the results of his work for publication in *Novitates*.

Mr. Jesse L. Nusbaum, the director of the Laboratory of Anthropology of Santa Fé, New Mexico, has made his headquarters in the department of anthropology, American Museum, during a short visit following the annual meeting of the Board of Trustees of the Laboratory, which, for the convenience of its members was held recently at the Museum. One of the important objectives of the Laboratory of Anthropology is the coördination of anthropological work in Southwestern United States, the principal area of its activities. Consequently, the department of anthropology has worked in close coöperation with the Laboratory, and several joint archæological projects have been carried through. The department is under special obligation to the staff of the Laboratory for coöperation in the preparation of an exhibit now in the Southwest Indian Hall, demonstrating the dating of archæological ruins by correlation with the age of beams found in the ruins, according to the method devised by Dr. A. E. Douglass.

Wyoming Fossil Dinosaur Collection

The work of excavation at the now famous dinosaur quarry at Cloverly in the Big Horn Basin, Wyoming, was finished about the middle of November, and the collection, contained in 144 cases, has arrived in the American Museum. Mr. Carl Sorensen of the palæontological department laboratory, who has had direct charge of this field work under the supervision of Dr. Barnum Brown, has returned to the Museum, and it is expected that the task of preparing this collection will begin the first of the year. Doctor Brown reports that, aside from the two or more mountable skeletons of the great sauropods which can be assembled from this great mass of material, its chief value is that it represents the reptilian fauna of this region during Upper Jurassic or Lower Cretaceous time and helps to give an insight into conditions of environment.

A Wurtemburg Dinosaur Skeleton

A new dinosaur skeleton is about to be added to the Hall of Dinosaurs in the American Museum. This is the most primitive of all of our dinosaurs. It is known as *Plateosaurus* and comes from the Triassic beds of Wurtemberg, and is, as it happens, the only skeleton in the great Dinosaur Hall to come from outside of North America. *Plateosaurus* was bipedal in locomotion, about twenty feet long, and with teeth on the border line between the true carnivorous and herbivorous types. The mounting has been most skilfully done by Mr. Charles J. Lang.

A Record Proboscidean Tusk

What is probably the record proboscidean tusk will shortly be placed on exhibition in the Age of Man Hall at the American Museum. This is the gigantic right tusk of the imperial mammoth which was discovered, collected, and presented by one of the Museum's life members, Mr. George D. Doughty of Post, Texas. The tusk comes from the vicinity of Mr. Doughty's home in Post, Texas, in which region the imperial mammoth seems to have flourished in Pleistocene times. For many years the department has had on exhibition a skull of the imperial mammoth, also from Texas, with a well preserved pair of tusks, one of which is 13 feet 6 inches in length, measured along the outside of the curve. The new tusk measures 15 feet 4 inches, and has an extreme circumference of 25 inches. Its weight as fresh ivory must have been nearly 300 pounds, and only the greatest of all proboscideans could have carried a pair of such enormous tusks.

Art Studies in the Field

Mr. and Mrs. John C. Germann, artists on the staff of the American Museum, have just completed a 9000-mile motor car trip through the Rocky Mountain region to secure color notes of the principal Tertiary mammal-bearing formations. Twenty-one sketches in oil representing twenty-four formations were made.

These sketches will be used in the preparation of four geologic and faunal charts for the Age of Mammals Hall, showing the various important formations in their comparative thickness and with scale restorations of the typical fossil mammals found in each horizon.

Instead of the ordinary geologic charts with simple horizontal bands of arbitrary coloring, these new charts will show actual scenes of various important fossil localities superimposed one upon the other and with true coloring.

Trailside Museum Activity

The Bear Mountain Trailside Museums and Nature Trails, operated jointly by the American Museum of Natural History and the Commissioners of the Palisades Interstate Park, now remain open throughout the year. During the winter season, the main Nature Trail has been kept open and has been used by the public continuously. The new Trailside Historical and Indian Museum has also been operated during the winter and, in addition, the Trailside Geology Museum and the Trailside Crafthouse have been opened daily.

The Trailside Crafthouse has been furnished to house animals that were formerly kept in the Trailside Museum in the center of the Nature Trail area. Since January 1, 1934, more than 390,000 persons have visited the Trailside region.

Thanks to the employment of men through the "T.E.R.A." the "C.C.C." and the "C.W.A.," the entire region has been vastly improved during 1933 and 1934. Four new museum buildings have been erected during this time. In all there are now five Trailside units. The original Trailside Museum was completed in 1927, the Geology Museum and the Crafthouse in 1933, and the Historical and Botanical Museums in 1934. The new museums are grouped near the automobile approach, beside the Bear Mountain Bridge toll house, and in no way encroach upon the Nature Trail area.

The new Trailside Botanical Museum has proved a most valuable teaching asset. Here a concentrated, highly important story is told. Living plants, charts, mechanical devices, and a large cut flower exhibit, (324 species shown during the season), held the interest of visitors throughout the summer.

For a number of years there has been a need for an Historical Museum in which to exhibit local, historical, and Indian collections. During the winter and spring, 1934, a beautiful building was designed and built. The structure stands in the center of old Fort Clinton, where an engagement of the American Revolution took place in 1777.

PERKINS DRIVE

Trailside attendance has increased greatly during the current year. One of the principal factors in this connection was the opening of the George W. Perkins Memorial Drive, on October 31, 1934. The number of Trailside visitors increased in direct proportion to the great number of persons who visited the road during the fall and winter. The new road leads directly to the top of Bear Mountain and is five and one half miles long. It has been completely landscaped. More than 433,530 square feet of sod alone have been laid down. Trees, shrubs, and wild flowers have been transplanted over an area of 86,700 square feet.

The Perkins Memorial Tower, at the summit of Bear Mountain, is sixty feet high. The mountain is 1305 feet high. A magnificent view extends on every hand. The tablet on the tower bears the following inscription:

> This Drive and Tower are dedicated by the
> Commissioners of the Palisades Interstate Park
> to the memory of
> George Walbridge Perkins
> Their first President, 1900–1920, whose broad
> vision and tireless energy made possible the
> preservation of the Palisades and the establishment of this great playground for humanity.
> 1934

ECOLOGICAL SURVEY

Commencing in the spring and continuing on through the winter, the Trailside Museum secured the services of two "Wild Life Technicians" through the "C.C.C." branch of the Department of the Interior. As there were no definite plans formulated for these men, the Trailside Museum decided to use them to make a wild-life survey of the Bear Mountain-Harriman section of the Palisades Interstate Park.

Under Trailside advice and supervision the men were sent into the field to make daily observations of birds and mammals, to keep daily notes, and eventually to report upon the various regions of the park as to predominant plant and animal life in each section studied. The information gained to date has been of real importance.—W. H. C.

Free Education Tours at the American Museum

Among the new educational broadcasts by the department of education of the American Museum is one on Thursdays at 5 P.M. over WNYC, in addition to the program on Saturdays at 6:30 P.M. over WOR. Responses to both of these at the follow-up tours in the Museum on Saturday afternoons at 3 P.M. average about 100 persons per trip. The programs for January and February over WOR, and for January, February, and March over WNYC, are given herewith.

WOR

Saturday	6:30 P.M.	John R. Saunders
Jan. 5		"Dinosaur Eggs"
12		"A Bird a Day"
19		"A Kayak for Two"
26		"Jade"
Feb. 2		"Penguin Prattle"
9		"Eleven Men of Science"
16		"Survival of the Fittest"
23		"The Sun Dance"

WNYC

Thursday		5:00 P.M.
Jan. 3	"Drama of the Microscopic"	Robert R. Coles
10	"Evolution of the Horse"	John R. Saunders
17	"Denizens Beneath the Seas"	Robert R. Coles
24	"Upside-down Geography"	John R. Saunders
Jan. 31	"Nature, Fact and Fiction"	Robert R. Coles
Feb. 7	"Cave Paintings"	John R. Saunders
14	"Whale Stories"	Robert R. Coles
21	"The Wolf"	John R. Saunders
28	"Pond Dwellers"	Robert R. Coles
Mar. 7	"Drums"	John R. Saunders
14	"Eskimo Life"	Robert R. Coles
21	"Bamboo"	John R. Saunders
28	"Pearls"	Robert R. Coles

Theodore Roosevelt Memorial

The Memorial is now in its fifteenth year, since it had its beginnings within three weeks of the untimely death of Theodore Roosevelt, January 6, 1919. Again we are reminded of the saying:

"Art is long, and time is fleeting—"

In every detail the Memorial will be a great work of art as well as a great tribute to the many-sided character of Theodore Roosevelt. The artists who have been especially concerned since the architectural competition of the year 1925 are John Russell Pope and Otto Eggers of the firm of John Russell Pope. The sculptors are James E. Fraser, who is executing the equestrian statue for the east façade and who has completed and set in place the superb figures of the great American explorers and naturalists, Lewis, Clarke, Boone, and Audubon. Also Edward F. Sanford, Jr., has carved the bas reliefs on the balustrade. The great mural paintings of the interior are in the hands of William A. Mackay. At the present time a number of other artists are being engaged, especially for the educational decoration of Floor I, which will be entitled Natural History of New York Hall and which will epitomize the great lives and works of the geologists, palæontologists, and zoölogists who were nurtured and trained in the Empire State and later led the successive geological surveys of our western territories and states. The Trustees are determined that the Natural History of New York shall afford inspiration to all the rising young naturalists and potential explorers of New York State.

The building is now two years behind the contract time and several months will elapse before it can be completed without and within. It may prove possible to keep the costs within the terms of the final Act of the Legislature (Chapter 265, Laws of 1930): "As a tribute to the memory of Theodore Roosevelt there shall be erected . . . an education building, chiefly for the benefit of the youth of the State, which shall hereafter be known as . . . the New York State Roosevelt Memorial."—H. F. O.

Mastodonts and Elephants

One is reminded of the saying, "Rome was not built in a day," by the long period of time it has taken to produce the Proboscidea Memoir which is now in its twenty-seventh year. It really began with the discovery of the ancestors of the Mastodonts embedded in the sands of the ancient River Nile, about sixty miles southwest of Cairo. After the English discoverers had published a memoir describing these most interesting fossils, President Jesup financed an expedition headed by Professor Osborn and Curator Granger who began big-scale digging in the American Museum method, with the aid of George Olsen and a large force of natives from Kuft, previously experienced in archæological work. This collection was given to Matsumoto, Japanese palæontologist, to describe, and it inspired Professor Osborn to take up the story of Proboscidean migration from Egypt to every continent of the world except Australia.

The late Lindsay Morris Sterling began the illustrations which on her lamented death were continued by other artists. Six years ago Margret Flinsch came over from the Frankfurt Museum to undertake the restorations. Meanwhile, with the coöperation of Professor Gregory, Professor Osborn began the intensive study of fossil Mastodonts and Elephants in all the museums of the world, and with the completion of the Titanothere Monograph in 1920 set to work upon the preparation of the text. The subject grew in interest by leaps and bounds, and has finally resulted in a complete revolution of our knowledge of the Mastodonts and Elephants, of their migrations and habits, and of their almost infinite adaptations to life in all environments from the arctic tundras surrounding the North Pole to the deserts of western America, the mountains of the Andes and the pampas of the Argentine. Next to man the Proboscidean proves to be the most versatile and successful explorer and traveler the world has ever known. Every week adds some discovery of interest. The latest accession to the remarkable American Museum Proboscidean collection is the record tusk of a gigantic imperial mammoth from Texas which will soon be on exhibition in the Hall of the Age of Man.

It is expected that Volume I, the Mœritheres of North Africa, the Deinotheres of Africa and Eurasia, the Mastodonts of the northern and southern hemispheres, will be published before the close of the present year, in order that the new discoveries may bear the date 1934. Volume II, the Stegodonts and the Elephants, will be worked out during the year 1935.

"Meshie"

Meshie Mungut, famous "Child of a Chimpanzee," owned by Mr. Harry C. Raven, associate curator in the department of comparative anatomy of the American Museum, has taken up her residence at the Zoo in Brookfield, Chicago, whither she traveled early in December.

Mr. Raven, who left New York on December 4 for a long trip into the interior of Burma with the Vernay-Hopwood-Chindwin Expedition, was faced with the problem of providing a suitable home for his remarkably intelligent pet, where she could be happy and comfortable, and grow into adulthood with others of her kind. She now weighs nearly 70 pounds, and is becoming too strong and quick to be trusted as a playmate for Mr. Raven's three children, who have been her companions for several years. Mr. Raven finally accepted the offer of the Chicago Zoological Society to purchase her and establish her in their beautiful zoo at Brookfield.

Meshie was born in February, 1929, in French Cameroun, West Africa, and was bought by Mr. Raven from some native hunters who had killed and eaten her mother. Meshie was then but a few months old.

Many of the adventures and accomplishments of Meshie have been described in the pages of NATURAL HISTORY by Mr. Raven.

Unique Food Plant Exhibit

Among the notable entries at the fall flower show of the Horticultural Society of New York, November 15–18, at the American Museum of Natural History, was the picturesque educational exhibit of the New York Botanical Garden. A gold medal was awarded for the display, which demonstrated the geographic origins of the principal cultivated food plants of the world.

Sugar-palm in Blossom

The sugar-palm whose topmost leaves touch the peak of the ninety-foot dome in the main conservatory at the New York Botanical Garden is finally blossoming this fall. Tassels a yard long, thickly studded with greenish flowers, hang from among the leaves near the top of the tree. Dr. Elmer D. Merrill, director, who has seen many trees of this type in their native habitats, declares that about every month or so a new inflorescence will come out, each from the axil of the next lower leaf, until the lowest leaf is reached. Then the tree will die.

This sugar-palm, which botanists now know as *Arenga pinnata*, after having for years incorrectly called it *Arenga saccharifera*, might be known as the thirty-year tree, because in Malaya, the land of its origin, and in the many Pacific Islands where it has been introduced, it lives about thirty years, then it blossoms and dies.

The natives, however, frequently give it no opportunity to live its full life span, for the tree furnishes many important products for them. From the flower stalks, sap is obtained which is boiled into excellent sugar or fermented into a palatable wine, in the Philippines called tuba. Other parts of the tree furnish a durable thatch for houses, fibers for rope, caulking for boats, and other materials for brooms, baskets, raincoats, and an inferior sort of tapioca. In addition, the nuts, the pulp around which is filled with millions of microscopic needles of oxalate of lime, are cooked and eaten. The tree will remain as a public exhibit in the conservatory as long as it blossoms and lives.

Recent American Museum Publications

NOVITATES

No. 752. New American Asilidae (Diptera). III. By C. H. Curran.

No. 753. Studies of Peruvian Birds. XIV. Notes on the Genera *Dendrocolaptes*, *Hylexetastes*, *Ziphocolaptes*, *Dendroplex*, and *Lepidocolaptes*. By John T. Zimmer.

No. 754. A New Species of Antilocaprine, *Tetrameryx Onusrosagris*, from a Pleistocene Cave Deposit in Southern Arizona. By Quentin Roosevelt and J. W. Burden.

No. 755. Two New Fresh-Water Fishes (Percesoces) from New Guinea. By J. T. Nichols and H. C. Raven.

No. 756. Studies of Peruvian Birds. XV. Notes on the Genus *Xiphorhynchus*. By John T. Zimmer.

No. 757. Studies of Peruvian Birds. XVI. Notes on the Genera *Glyphorhynchus*, *Sittasomus*, *Deconychura*, *Margarornis*, *Premnornis*, *Premnoplex*, and *Sclerurus*. By John T. Zimmer.

BULLETIN

Volume LXVIII Art. 1.—Mammals Collected by A. W. Anthony in Guatemala, 1924–1928. By George G. Goodwin.

Recently Elected Members of the American Museum

Since the last issue of Natural History, the following persons have been elected members of the American Museum:

Associate Benefactors

Messrs. Edmund P. Rogers, William K. Vanderbilt.

Patron

Mr. Harry Snyder.

Fellow

Mr. E. L. Bell.

Honorary Life Member

Dr. A. B. Klots.

Life Members

Messrs. Raymond Guest, Kerr Rainsford.

Sustaining Members

Mrs. Frederick S. Wheeler.

Messrs. H. E. Talbott, Jr., Daniel Bertsch Wentz, Jr.

Annual Members

Mesdames Hugh Symthe, Lyman Beecher Stowe.

Misses Olivia Green, Anna J. Rothschild, Della R. Voss, B. Violet Walter.

Dr. I. Sossnitz.

Messrs. Bertram A. Gabriel, Louis H. Hertz, Wilson Parkhill, Maurice J. Schless, Henry Seton, Samuel M. Siegman, William W. Sisson, Walter Stabler.

Associate Members

Mesdames Mary E. Bing, Nathaniel W. Bishop, Mary E. Browning, Chas. Reed Cary, E. N. Clark, Alicia A. Condon, George B. Crawford, W. F. Dummer, Henry DeWitt Hamilton, Adelaide B. Harris, George H. Healy, M. Hereford, Priscilla Bache Hoffman, Robert S. Holt, R. W. Homan, Dunlap Hopkins, George Preston Hotaling, Ernest Howe, Loleta Johnson, H. L. Lloyd, A. I. Moriarty, L. Haviland Nelson, Eleanor L. O'Connell, Madge Peck-Hall, May M. Pennock, Laura A. Quinlan, Frank Mason Robinson, Martin Shaughnessy, Stockbridge Smith, Harry Sokolov, Mary Spiegel, Harriet G. Stillman, Amos A. Steele, Constance Tipson, Tillie M. Wilcox, Edward L. Williams.

Misses Cornelia Bartels, E. Leanore Bowker, Rose Branca, Marjorie L. Bredehorn, Lena Briant, Helen J. Carl, Jessie G. Carter, Lillian R. Conant, Nell Cramer, Minnie Louise Davis, Emma Dean, Veronica C. Dundon, Mildred P. Ellis, Elsie Erdwurm, S. Lois Fassett, Flora G. Feldman, Eleanor Fischer, Ethel Fisher, Evalyn E. Gardner, Helen Goldstrom, J. Burnette Hallowell, Emily L. Hanna, Harriet E. Harrington, Ellen Hayes, Hannah Mee Horner, Emma C. Janson, Anna S. Johnson, Mary C. Johnstone, Katharine M. Jones, Anna May Ker, Katherine E. MacDonnell, Sara B. MacGowan, Gertrude M. McPartland, Elizabeth A. Miller, Emma W. Moore, Helen A. Munro, Marion C. Murphy, Edith Newlin, Fay T. Preston, Elizabeth P. Rush, Louise R. Ryan, Margaret F. Scanlon, Gertrude Adelaide Service, Catherine Sheridan, Jessie Millard Stevenson, Grace P. Stone, Anna Van Vleck, Lillian Lane Wheaton, Mary A. Wright, Louise M. Young, Betty Zitzmann.

Reverend Doctors Herbert E. Benton, Francis J. Bredestege, R. C. Cleckler.

Reverends John R. Atwill, Canon S. H. Middleton, William H. Watts.

Lieut. Colonel Thos. D. Osborne.

Lieut. Comdr. Percival W. Buzby, U.S.N. (Ret.).

Captains George Fein, Chas. C. Morgan, U.S.A.

Doctors Leland L. Atwood, Richard T. Beebe, W. S. Bonnalie, A. Leo Brett, L. Gordon Brown, Fred Brush, Wendell Chapman, M. A. Chertok, William Frederick Clark, J. Frederick Close, John De Carlo, R. E. Ellegood, Ing. Feodore F. Foss, Clarence F. Graham, W. A. Ham, Elmus K. Hanby, J. Glen Harbison, John B. Hartwell, Robert S. Heeb, Samuel S. Hill, A. Bern Hirsch, Barbara Hunt, Everett O. Jones, Herman H. Jensen, Charles B. Kaighn, Jos. S. Lawrence, Irwin P. Levi, Leo B. Meyer, Ignatius J. Murnane, Homer L. Nelms, John T. Oliver, G. W. Olson, A. I. Ortenburger, Rowland G. Paynter, Jesse R. Prichard, John Repasky, Byron L. Robinson, Marion R. Sandalls, John M. Scanland, Paul C. Shoemaker, Leo Stein, Hannah M. Stone, Louis Thomas, Frank Oliver Wood.

Professor Elliott S. Smith.

Messrs. A. C. Albrecht, F. W. Allcorn, Jr., Lewis W. Allen, Charles Lynnwood Andrews, F. J. Appell, Friedrich M. L. Arntz, Rowland W. Bachman, Geo. C. Barclay, H. C. Barkman, Charles H. Bartlett, Louis C. Bartol, J. W. Berryman, Fred Blanchard, James S. Blazer, R. I. Bond, Martin Bordelon, Martin Borgord, A. P. Brantley, Henry G. Brooks, Guy A. Brown, Newton Brown, Ray S. Brown, Ray M. Bush, I. C. Bushong, Wallace L. Caldwell, Henry Warder Carey, Walter M. Carter, E. O. Cathcart, P. Stenning Coate, Burnham S. Colburn, James F. Cox, L. K. Dalrymple, Leigh Danenberg, J. T. Davidson, Henry Davis, Jr., Abel De Barros, William A. Desmond, Joseph B. Dibrell, Jr., Robert Runyon Diefendorf, R. F. Dillard, Robert R. Dince, Jr., C. T. Edgar, Abraham Ehrenfeld, Walter S. Ehrenfeld, Edward Eliot, Leland H. Follett, George B. Francis, Walter Frankle, James D. Garrett, Taylor Gates, Harold L. Gill, Chas. J. Grayson, Walter L. Guernsey, John K. Gustafson, Dudley Hall, Spotswood B. Hall, W. J. Halloran, Osborne Halsted, J. E. Halverson, John Theodore Haneman, Jr., G. R. Harding, Charles A. Hardy, Lamar Hardy, H. M. Hargrove, C. R. R. Harris, Albert A. Harrison, Carter H. Harrison, Reginald W. Hartwell, George A. Haslam, J. S. Heckathorn, Edward M. Hellerman, Edward Waldron Hicks, Charles Willard Hill, William A. Hines, Isaac Hirsch, Bexley Hocombe, Raymond Auguste Hodier, Walter G. Holmes, Hugh B. Hooper, James F. Hooper, Stephen V. Hopkins, Joseph Hormats, Henry Hornblower, 2d, T. A. Hostetler, Amory Houghton, E. O. Howard, John E. Hughes, Geo. Johnson, Gordon K. Johnson, W. A. Ketchum, Delford L. Knapp, Edw. J. Lenger, George P. Lester, Harry Levine, C. M. Lockwood, Lingard Loud, James G. Ludlum, Finlay L. MacFarland, R. H. Miller, Van Roy Miller, Aurelius Mirenda, John A. Moore, Burrell Morgan, Arthur Q. Morrison, Oliver N. Nash, John D. Newman, Jr., Abbott L. Noble, Robert J. Noyes, Geo. W. Oakes, Jr., William Francis O'Kelly, Arthur William Ormond, Aylmer B. Paisley, W. H. Peck, Andre N. Pickard, W. C. Plunkett, William E. Pool, Robert Y. Pratt, Winfield Pearce Prentiss, Newell E. Qualle, John G. Quinlan, John Rechholtz, J. D. Repp, Lewis M. Rhodes, Norman K. Roessler, William Rosenberg, L. R. Ruth, Robert Schenken, Samuel Semple, C. J. Shannon, Jr., David Sharman, Jr., C. A. Shepard, Frank Shultis, Edward A. Simons, H. E. Sloan, Arthur W. Smith, Eugene Eaton Smith, Fred Crego Smith, Nathaniel W. Smith, William G. Smith, Robert J. Sosenko, Hughes Spalding, Maurice W. Spear, Robert Spindler, Charles G. Squibb, A. C. Stamm, Herman J. Stangier, Charles W. Staples, S. Tagart Steele, David E. Stokes, Mason A. Stratton, Edward Du Bois Stryker, Arthur L. Swanson, Sherman G. Swigart, Adolph R. Swoboda, Frank Ternansky, Jr., J. Sheldon Toomer, John H. Truex, Raymond L. Vachon, John Van Klink, John L. Webb, Albert P. Wiggins, Roy Wilkins, Josiah J. Willard, L. E. Wilson, J. E. Woodard.

Reviews of New Books

Recent Publications For Those Interested in Nature

Confessions of a Scientist. By Raymond L. Ditmars. The MacMillan Company, New York. 1934. 241 pp. Illus.

DOCTOR DITMARS during the years he has been in charge of the collection of reptiles and mammals at the New York Zoological Park has accumulated a wealth of experience not only with these animals but with the public interested in learning more about them. The present volume combines a series of personal, almost confidential, talks about many phases of his work in the field, at the Zoo, in the motion-picture laboratory, and on the lecture platform. The chronicle is of particular interest to New Yorkers who have seen their Zoological Park grow to an institution of such importance in scientific and educational fields.

A lifetime as rich as Doctor Ditmars could not be crowded into one volume, and most of the incidents considered are those of recent occurrence. Doctor Ditmars has captured a vampire bat in a Panamanian cave and has studied it and its young for long periods at the Zoo. He speaks of the pleasures of observation, and the difficulties of making sure that these records are really new to science. Doctor Ditmars has aided investigators in their recent utilization of snake poison in the treatment of cancer and hemorrhage. He describes the pleasure of aiding in real scientific achievement and expresses the hope that snake poisons will find wide application in the relief of human ailments. He tells what goes on behind the scenes at a great Zoological Park, the difficulties of accepting pets, and of securing dignified and yet adequate publicity. The letters of inquiry concerning snakes outnumber all others received in the combined animal departments of the Park, and hence Doctor Ditmar's desk work alone is no small part of his job. From all the recent happenings in Zoo, motion picture studio, and field, he has selected the most interesting and described them in a delightful style. The book will appeal to all lovers of animal life and especially to those who have followed the rise and the development of the New York Zoological Park.—G. K. N.

Half Mile Down. By William Beebe, Sc.D., LL.D. Director of the Department of Tropical Research of the New York Zoological Society. With 123 illustrations and 8 colored plates. Published under the auspices of the New York Zoological Society. 344 pp. Harcourt Brace and Co., New York. 1934.

THERE is nothing new under the sun, but who goes where no one has been has merely to keep his eyes open to be in a position to add to the sum total of human knowledge. He who has penetrated to unusual places or has had unusual experiences, possesses something of general or particular interest. The observations, beliefs, and point of view of such a one mean something, and are of interest even if you do not share them. So it is that the data of exploration have a certain human freshness frequently lacking in more authoritative data of the stay-at-home investigator. They are as a breath of fresh air in the sometimes musty corridors of scientific thought; and Science and Exploration go very happily hand in hand.

The sea is old, so old; but descents to unprecedented depths beneath its surface have the glamour of all true exploration, of penetrations into a relatively unknown world. When down goes Dr. William Beebe in his bathysphere off Bermuda to a final record depth of well over half a mile, it is as though Science for the first time had lowered a sensitized human photographic plate into the abyss. Now it has been drawn up again, and we who are interested turn to this book, each with a different interest dependent on who we are and our respective philosophies of life. Let none of us forget that it is not just a book.

Such of us as have followed the details of Dr. Beebe's deep sea work with the bathysphere as reported in serial publications of the New York Zoological Society will find here a good deal of material with which we are already familiar. Then there are fascinating chapters concerned with methods and ideas of the earliest divers. We learn of Gustav Kobbe's claim of the world's record for fast walking under water; of various diving bells, of Borelli's invention in 1682 of a quite impractical apparatus, which, however, contained the germ of the idea which has made all modern diving possible,—the removal of confined air and the substitution of fresh. The conception, construction and behavior of the bathysphere and its equipment are gone into with much detail, as well as occupying a considerable place in the narrative of observations in the depths, which to a naturalist are the most interesting and important part of the book.

Finally we have observations in the summer of 1934 from the last and deepest dives, emphasizing what seem to the writer their most important features, and a summary of new light thrown on the environment and lives of deep-sea creatures by his bathysphere descents.

At great depths through the fused glass window of his iron ball, Doctor Beebe has seen clearly enough to describe in considerable detail three or four kinds of fishes which seem to be not merely undescribed species but quite unlike their nearest relatives known to science. It was to be expected that observations of this sort would be made, in fact the possibility or even probability of such observations was one of the principal *a priori* interests in the descent. He has had illustrations of these new fishes prepared, as accurate as possible, from his memory and notes, and has given to each a technical scientific name, just as though a specimen had been obtained to be filed away for reference in the archives of some museum. Herein there is a departure from the convention that demands that a new form be based on some definite specimen in hand, and in general any such practice of naming observations is to be condemned and the names given, perhaps appropriately, disregarded. In this exceptional circumstance, however, where unobtainable fishes can be observed in some detail, it is certainly of value and fitting to have a name to discuss them by. The purpose of science should in all cases have right of way over its practices, and the right course seems to have been followed.

Doctor Beebe is assuredly less hampered by standard inhibitions than many of his scholarly friends, which frequently leads to his being criticized as well as commended. We think of this when he names his retinal image of a strange fish, when he writes in a manner dramatic rather than meticulous, and most of all when we stand before the iron ball he calls a bathysphere now resting in the American Museum's Hall of Ocean Life. Then only can one properly place in one's mental catalogue of human achievement, that on August 15, 1934, William Beebe and Otis Barton, in quest of an ever-young lady known as Truth (wearing as a veil the ocean), descended in this same iron ball 3028 feet, well over half a mile, into the perpetual black night of the depths of the sea,—and then only can one place this book on its proper shelf.—J. T. N.

Fog. By Alexander McAdie. The Macmillan Co., New York, 1934. 23 pages of text, 52 pages of plates.

THIS well illustrated book by an expert meteorologist commands attention. The brief text states how fog is formed, its nature and characteristics, and reveals some of the methods which have been tried in dispelling it. Most of these methods, however, except in small enclosed spaces, have proved to be too expensive to be undertaken out of doors. The author states that air and fog are separate entities, that the air does not absorb the water-vapor, but carries it along, and that each of the entities has its own temperature, pressure, and density. He cites instances where fog has been very detrimental to the activities of great cities such as New York, London, and Berlin, also where it has influenced the course of history and where it has impeded even the daily routine of an entire nation. He states that we are safe in giving an estimate of twenty days each year when traffic in large cities is seriously impeded, if not suspended, by fog, with resulting high financial loss and notable injuries to human beings. He calls attention to the two kinds of fog that cause most trouble, namely: ground fog produced by radiation from the earth, and advective fog, the kind that is carried from place to place, such as sea fogs.

He states that much has been accomplished in connection with aviation in developing instruments which permit aviators to fly safely through fogs. He is of the opinion that continued study and experimentation may eventually produce methods whereby fog may be dissipated locally and thus facilitate shipping, aviation, and ground traffic in and near large cities.

The illustrations, which have been reproduced with notable artistic success, are excellent; the text matter, however, is in general most too technical for a ready understanding by lay readers.

—CHESTER A. REEDS.

The American Eagle. A Study in Natural and Civil History. By Francis Hobart Herrick. D. Appleton-Century Company. New York. London. October 26, 1934. 8 vo.

PROFESSOR HERRICK made his name familiar to students of American birds in 1901 when he published his notable *Home Life of Wild Birds* with its excellent photographs of the nesting activities of many familiar species. These photographs had been taken from an observation blind set up in close proximity to the nests. On occasion, when conditions were unsuitable for photography, the nests had been moved, with proper precautions, to more effective places, without disruption of the daily activities of the birds.

An apparent impasse was reached in the case of the American eagle,—that is to say, the bald eagle or, as the author philologically insists, the bald-headed eagle. The bulky nests of this species, placed at considerable heights in somewhat isolated trees, are all but inaccessible to the photographer and most certainly cannot be moved at will to more convenient situations. At an early date, therefore, in 1899, Professor Herrick conceived the idea of building a tower near an eyrie and placing his observation blind upon it, but many years were to elapse before the idea blossomed into use.

In 1922 the first experiments were made to determine the eagles' reaction to an alien structure erected near their nests. An elevated platform was built in a convenient tree and, with some additions to its height, was used for several years, until the nest was destroyed by a storm. As this experiment proved quite successful, a steel tower was erected in 1926 at a chosen site near another nest, later to be moved as circumstances directed. The following years saw many vicissitudes. Storms destroyed one eyrie and uprooted the tower; one set of eggs failed to hatch; a falling tree nearly caused disaster. Nevertheless, the work continued for seven seasons, to be terminated at last in June, 1930.

As may be imagined, trained observers like Professor Herrick and his assistants, sitting, day after day, unseen within (sometimes) a dozen yards of a family of these great birds, were able to make exceedingly careful observations on the minute-by-minute life going on before their eyes. Current reports of these observations were published from time to time in the pages of *The Auk* (1924, 1932, and 1933), and these have been collected and rewritten to make a complete record of the consecutive seasons of field work and additional experiments in the laboratory.

All the phases of an eagle's life at the eyrie during daylight hours are here set down, from the early infancy of the chicks (the actual hatching of the eggs was studied in the laboratory) to their final departure from the nest. The reactions of adults and young to their environment and to each other, their food and feeding habits, their vocal efforts, their play,—all are faithfully recorded.

One could wish that there were more information about the life of the birds away from the nest—their mating habits, their methods of capturing their prey, their activities during the winter, and similar topics which are very lightly touched, if at all mentioned. These facts, of course, are not to be learned from a single fixed post near the eyrie, occupied only while the young are in the nest, and within these implied, if not expressed, limits the given facts are relatively complete.

An attempt is made to group the subject matter under various chapter headings, but the result is not entirely satisfactory, and topics may be found discussed at several places in the volume with resulting confusion to the reader. This may, perhaps, be partly unavoidable because of the intimate interrelationships of the various activities of life in the nest and because the account deals with several families of eagles observed in different years. A good index, however, serves to bring the scattered observations together in accessible form.

Although the original studies deal entirely with the bald eagle, many supplementary notes are given regarding other species. The book concludes with a discussion of eagles as they appear in heraldry, in apotheosis, and in numismatics, with especial attention to their appearance on the emblems and coins of the United States. The pages are enlivened by a selection from the many excellent photographs taken from the observation blind and from other vantage points, and by illustrations of coins and heraldic devices showing this group of birds.

The work is one of the most complete studies of its kind that have appeared and forms a monument to the ability, patience, and untiring zeal of the author applied to a difficult task.—J. T. Z.

Wild Flowers. By Homer D. House. New York: The Macmillan Co. 1934. 364 full-color illustrations with complete descriptive text.

THIS is a gorgeous book of the wild flowers of eastern North America. Although by no means complete, it contains nearly 400 of our most conspicuous wild flowers. Each plant is represented by a beautiful, large, colored plate, made from a natural-color photograph or autochrome. In fact, these plates were originally made for the superb and deservedly popular set of two large volumes on the *Wild Flowers of New York*, under the supervision of the State Botanist, Dr. Homer D. House.

With the permission of the Board of Regents of the State of New York, Doctor House has used all of these colored plates, together with many excellent black and white photographs, in this new work of one volume. The text descriptions are non-technical and brief. Both common and scientific names are given, and the range of the plant. In short, we have here a book "with many pictures and little reading," which was not prepared for the technical botanist, but for the layman who would like to name the flowers without a key, but by the aid of pictures.

The book is a thing of beauty. An examination of the exquisite plates in faithful natural colors will recall many delightful associations on the part of all lovers of the outdoors. It is a book to own and to enjoy. We predict a wider popularity than that of its predecessor, *The Wild Flowers of New York*.

—CLYDE FISHER.

Talking Leaves. By Julius King. Cleveland, Ohio. Harter Publishing Co. 1934.

HERE is an attractive and useful little book which describes more than fifty of our most common trees, one page being devoted to each kind. There is just a brief paragraph of text about each tree, the most important part of the treatment being the illustrations of which there are three. First there is a drawing of the tree as a whole showing the general habit of the species, but these are too small to be very helpful. The approximate height of each tree is printed below each of these drawings. The drawings of the leaves, flowers and fruits, on a scale large enough to occupy about half of each page, are by far the more valuable aids in identification. The third illustration is a map of the United States, showing the range of the tree in green shading, thus constituting an important feature of the little book.

—CLYDE FISHER.

BOOKS BY MUSEUM AUTHORS
for sale by THE AMERICAN MUSEUM OF NATURAL HISTORY

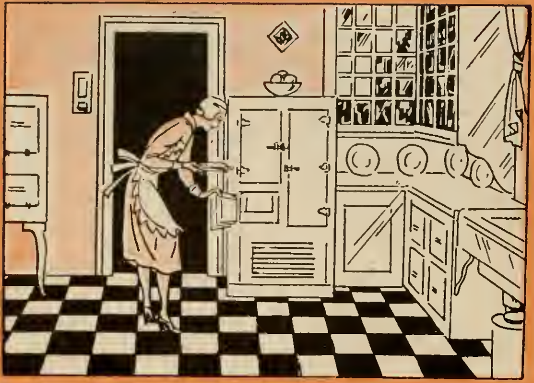
AKELEY, CARL AND MARY JOBE	
Adventures in the African Jungle	$3.00
Lions, Gorillas and Their Neighbors	2.50
AKELEY, MARY JOBE	
Carl Akeley's Africa	5.00
ANDREWS, ROY CHAPMAN	
Across Mongolian Plains	5.00
Ends of the Earth (1st edition 1929)	4.50
Ends of the Earth. (Star edition)	1.00
On the Trail of Ancient Man	6.00
Whale Hunting with Gun and Camera	5.00
ANDREWS, ROY CHAPMAN AND YVETTE BORUP	
Camps and Trails in China	5.00
ANTHONY, H. E.	
Field Book of North American Mammals	5.00
Bartlett, "Bob" Sails Over Ice	3.00
BEEBE, WILLIAM	
The Arcturus Adventure	7.50
Beneath Tropic Seas	3.50
Galapagos, World's End	6.00
Jungle Days	3.00
Pheasant Jungles	3.00
Half Mile Down	5.00
BEEBE, WILLIAM AND TEE-VAN, JOHN	
Field Book of the Shore Fishes of Bermuda	3.50
BRAND, A. R.	
Songs of Wild Birds. (Has two phonograph records, songs of 35 birds)	2.00
BREDER, C. M., JR.	
Field Book of Marine Fishes of the Atlantic Coast	5.00
CARR, WILLIAM H.	
Glimpses of Familiar Birds	1.00
The Stir of Nature	2.50
CHAPMAN, FRANK M.	
Autobiography of a Bird-Lover	3.75
Bird-Life	4.00
Bird Studies with a Camera	3.00
Camps and Cruises of an Ornithologist	4.00
Color Key to North American Birds	4.00
Handbook of Birds of Eastern North America. 2nd Revised Edition. 1932	5.00
My Tropical Air Castle	5.00
Our Winter Birds	2.00
The Travels of Birds	.76
What Bird is That?	1.50
CLARK, JAMES L.	
Trails of the Hunted (First Edition)	4.00
Blue Ribbon Edition	1.00
COATES, C. W.	
Tropical Fishes for a Private Aquarium. (Tropical Fishes as Pets)	2.00
CURRAN, C. H.	
The Families and Genera of North American Diptera	7.50
DARWIN, LEONARD	
What is Eugenics?	.50
GRANT, MADISON	
Passing of the Great Race	$3.50
GRAY, PRENTISS N.	
Records of North American Big Game	10.00
GREEN, FITZHUGH	
Roy Andrews — Dragon Hunter (A book for boys about Dinosaurs and Bandits)	1.75
GREGORY, WILLIAM KING	
Our Face from Fish to Man	5.00
Man's Place Among the Anthropoids	2.50
HARING, H. A.	
The Slabsides Book of John Burroughs	2.50
JOHNSON, MARTIN	
Cannibal-Land	1.00
Lion	5.00
Safari	5.00
JOHNSON, OSA HELEN	
Jungle Babies	1.75
KARAZIN, N.	
Cranes Flying South	2.50
KUNZ, GEORGE F.	
The Magic of Jewels and Charms	8.50
Rings for the Finger	8.50
LEDERER, N.	
Tropical Fish and their Care	2.50
LEIGH, W. R.	
The Western Pony	10.00
LAMONTE, FRANCESCA AND WELCH, MICAELA	
Vanishing Wilderness	2.50
LORIMER, FRANK AND OSBORN, FREDERICK	
Dynamics of Population	4.00
LUTZ, FRANK E.	
Field Book of Insects	3.50
MCCREERY, JAMES LINDSAY	
Exploring the Earth and Its Life	2.00
MCKENNY, MARGARET	
Mushrooms of Field and Wood	2.00
MCSPADDEN, J. WALKER	
To the Ends of the World and Back. Scouting for a great Museum (The American Museum of Natural History)	3.00
MANN, PAUL B., AND HASTINGS, GEO. T.	
Out of Doors. A Guide to Nature	2.00
MASON, GREGORY	
Columbus Came Late	4.00
MEAD, MARGARET	
Coming of Age in Samoa	3.00
Growing Up in New Guinea	3.50
The Changing Culture of an Indian Tribe	4.50
MEDSGER, OLIVER P.	
Nature Rambles *Spring*	2.00
" " *Summer*	2.00
" " *Autumn*	2.00
" " *Winter*	2.00
MORDEN, WILLIAM J.	
Across Asia's Snows and Deserts	5.00
MURPHY, ROBERT CUSHMAN	
Bird Islands of Peru	5.00
NICHOLS, J. T. AND BREDER, C. M., JR.	
The Marine Fishes of New York and Southern New England	$1.40
NOBLE, G. KINGSLEY	
The Biology of the Amphibia	5.00
OSBORN, HENRY FAIRFIELD	
Cope: Master Naturalist	5.00
Evolution of Mammalian Molar Teeth	2.75
Creative Education in School, College, University and Museum	2.50
The Earth Speaks to Bryan	1.00
Evolution and Religion in Education	2.00
Fifty-Two Years of Research, Observation and Publication, 1877–1929	1.50
From the Greeks to Darwin	2.50
Impressions of Great Naturalists	2.50
Man Rises to Parnassus. 2nd Edition	3.00
Men of the Old Stone Age. 3rd Edition	5.00
The Origin and Evolution of Life	4.00
REEDS, CHESTER A.	
The Earth. Our Ever-Changing Planet	1.35
SCHWESINGER, GLADYS C.	
Heredity and Environment	4.00
SIMPSON, GEORGE GAYLORD	
American Mesozoic Mammalia	5.00
Attending Marvels. A Patagonian Journal	3.00
STEFANSSON, V.	
My Life with the Eskimos — New and Abridged Edition	2.50
The Friendly Arctic	6.50
VANDERBILT, WILLIAM K.	
Across the Atlantic with *Ara*. Summer 1924	5.00
15,000 Miles Cruise with *Ara*. 1927	5.00
Taking One's Own Ship Around the World	30.00
To Galapagos on the *Ara*	30.00
West Made East with the Loss of a Day	20.00
WALKER, EDITH B. AND MOOK, CHAS. C.	
Tales of the First Animals	1.50
WISSLER, CLARK	
The American Indian	5.00
Introduction to Social Anthropology	3.50
Man and Culture	2.75
Relation of Nature to Man in Aboriginal America	3.50
Boy Scout Book of True Adventure	2.50
The Earth, the Seas and the Heavens. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00
Fishes, Insects and Reptiles. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00
Mammals and Birds. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00

Address orders to The Librarian

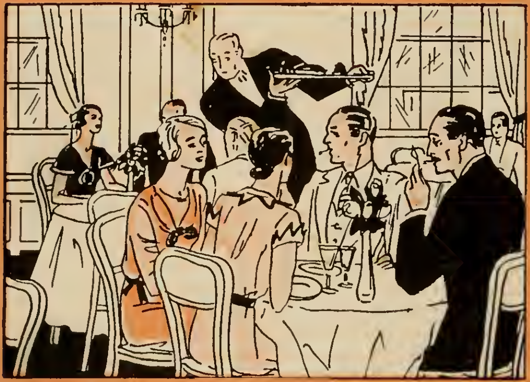
THE AMERICAN MUSEUM OF NATURAL HISTORY
77th STREET AND CENTRAL PARK WEST :: :: :: NEW YORK, N. Y.

Remittances must accompany all orders — Include 10 cents per volume for postage

A UNIQUE APARTMENT HOTEL COMBINATION



★ SUITES HAVE COMPLETE KITCHENS



★ FULL HOTEL SERVICE MAY BE UTILIZED AS DESIRED

Ideal East Side location just across Central Park from the Museum of Natural History; also convenient to the Metropolitan Museum of Art. Apartments of 2 to 6 rooms by the day, month, or year, furnished or unfurnished. The Croydon standards of service and equipment continue to be of the highest. Inspection of the unusually attractive model suites will be worth while. Sun roof, children's playroom, splendid restaurant.

Two rooms with kitchen and dining alcove...$125 to $250 monthly on lease, including hotel service. Rates without service are less. Accommodations for transients. Booklet N on request.

The Croydon

12 EAST 86TH STREET • NEW YORK • BUtterfield 8-4000

UNDER THE DIRECTION OF WILBUR T. EMERSON

NATURAL HISTORY

ebruary 1935

Fifty Cents

Journal of The American Museum of Natural History

BOOKS BY MUSEUM AUTHORS

for sale by THE AMERICAN MUSEUM OF NATURAL HISTORY

Akeley, Carl and Mary Jobe	
Adventures in the African Jungle	$3.00
Lions, Gorillas and Their Neighbors	2.50
Akeley, Mary Jobe	
Carl Akeley's Africa	5.00
Andrews, Roy Chapman	
Across Mongolian Plains	5.00
Ends of the Earth (1st edition 1929)	4.50
Ends of the Earth. (Star edition)	1.00
On the Trail of Ancient Man	6.00
Whale Hunting with Gun and Camera	5.00
Andrews, Roy Chapman and Yvette Borup	
Camps and Trails in China	5.00
Anthony, H. E.	
Field Book of North American Mammals	5.00
Bartlett, "Bob" Sails Over Ice	3.00
Beebe, William	
The Arcturus Adventure	7.50
Beneath Tropic Seas	3.50
Galapagos, World's End	6.00
Jungle Days	3.00
Pheasant Jungles	3.00
Half Mile Down	5.00
Beebe, William and Tee-Van, John	
Field Book of the Shore Fishes of Bermuda	3.50
Brand, A. R.	
Songs of Wild Birds. (Has two phonograph records, songs of 35 birds)	2.00
Breder, C. M., Jr.	
Field Book of Marine Fishes of the Atlantic Coast	5.00
Carr, William H.	
Glimpses of Familiar Birds	1.00
The Stir of Nature	2.50
Chapman, Frank M.	
Autobiography of a Bird-Lover	3.75
Bird-Life	4.00
Bird Studies with a Camera	3.00
Camps and Cruises of an Ornithologist	4.00
Color Key to North American Birds	4.00
Handbook of Birds of Eastern North America. 2nd Revised Edition. 1932	5.00
My Tropical Air Castle	5.00
Our Winter Birds	2.00
The Travels of Birds	.76
What Bird is That?	1.50
Clark, James L.	
Trails of the Hunted (First Edition)	4.00
Blue Ribbon Edition	1.00
Coates, C. W.	
Tropical Fishes for a Private Aquarium. (Tropical Fishes as Pets)	2.00
Curran, C. H.	
The Families and Genera of North American Diptera	7.50
Darwin, Leonard	
What is Eugenics?	.50
Grant, Madison	
Passing of the Great Race	$3.50
Gray, Prentiss N.	
Records of North American Big Game	10.00
Green, Fitzhugh	
Roy Andrews — Dragon Hunter (A book for boys about Dinosaurs and Bandits)	1.75
Gregory, William King	
Our Face from Fish to Man	5.00
Man's Place Among the Anthropoids	2.50
Haring, H. A.	
The Slabsides Book of John Burroughs	2.50
Johnson, Martin	
Cannibal-Land	1.00
Lion	5.00
Safari	5.00
Johnson, Osa Helen	
Jungle Babies	1.75
Karazin, N.	
Cranes Flying South	2.50
Kunz, George F.	
The Magic of Jewels and Charms	8.50
Rings for the Finger	8.50
Lederer, N.	
Tropical Fish and their Care	2.50
Leigh, W. R.	
The Western Pony	10.00
LaMonte, Francesca and Welch, Micaela	
Vanishing Wilderness	2.50
Lorimer, Frank and Osborn, Frederick	
Dynamics of Population	4.00
Lutz, Frank E.	
Field Book of Insects	3.50
McCreery, James Lindsay	
Exploring the Earth and Its Life	2.00
McKenny, Margaret	
Mushrooms of Field and Wood	2.00
McSpadden, J. Walker	
To the Ends of the World and Back. Scouting for a great Museum (The American Museum of Natural History)	3.00
Mann, Paul B., and Hastings, Geo. T.	
Out of Doors. A Guide to Nature	2.00
Mason, Gregory	
Columbus Came Late	4.00
Mead, Margaret	
Coming of Age in Samoa	3.00
Growing Up in New Guinea	3.50
The Changing Culture of an Indian Tribe	4.50
Medsger, Oliver P.	
Nature Rambles *Spring*	2.00
" " *Summer*	2.00
" " *Autumn*	2.00
" " *Winter*	2.00
Morden, William J.	
Across Asia's Snows and Deserts	5.00
Murphy, Robert Cushman	
Bird Islands of Peru	5.00
Nichols, J. T. and Breder, C. M., Jr.	
The Marine Fishes of New York and Southern New England	$1.40
Noble, G. Kingsley	
The Biology of the Amphibia	5.00
Osborn, Henry Fairfield	
Cope: Master Naturalist	5.00
Evolution of Mammalian Molar Teeth	2.75
Creative Education in School, College, University and Museum	2.50
The Earth Speaks to Bryan	1.00
Evolution and Religion in Education	2.00
Fifty-Two Years of Research, Observation and Publication, 1877–1929	1.50
From the Greeks to Darwin	2.50
Impressions of Great Naturalists	2.50
Man Rises to Parnassus. 2nd Edition	3.00
Men of the Old Stone Age. 3rd Edition	5.00
The Origin and Evolution of Life	4.00
Reeds, Chester A.	
The Earth. Our Ever-Changing Planet	1.35
Schwesinger, Gladys C.	
Heredity and Environment	4.00
Simpson, George Gaylord	
American Mesozoic Mammalia	5.00
Attending Marvels. A Patagonian Journal	3.00
Stefansson, V.	
My Life with the Eskimos — New and Abridged Edition	2.50
The Friendly Arctic	6.50
Vanderbilt, William K.	
Across the Atlantic with *Ara*. Summer 1924	5.00
15,000 Miles Cruise with *Ara*. 1927	5.00
Taking One's Own Ship Around the World	30.00
To Galapagos on the *Ara*	30.00
West Made East with the Loss of a Day	20.00
Walker, Edith B. and Mook, Chas. C.	
Tales of the First Animals	1.50
Wissler, Clark	
The American Indian	5.00
Introduction to Social Anthropology	3.50
Man and Culture	2.75
Relation of Nature to Man in Aboriginal America	3.50
Boy Scout Book of True Adventure	2.50
The Earth, the Seas and the Heavens. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00
Fishes, Insects and Reptiles. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00
Mammals and Birds. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00

Address orders to The Librarian

THE AMERICAN MUSEUM OF NATURAL HISTORY
77th STREET AND CENTRAL PARK WEST :: :: :: NEW YORK, N. Y.

Remittances must accompany all orders — Include 10 cents per volume for postage

NATURAL HISTORY

The Journal of the American Museum of Natural History

CONTENTS

VOLUME XXXV, NO. 2 FEBRUARY, 1935

Rif Tribesmen of North Africa . . . . *Cover*
From a Painting by Dudley M. Blakely

Daughters of the Rif . . . . *Frontispiece*

The People of the Rif . . . . Carleton S. Coon 93
The White Tribes of the Mountains of North Africa

Winter in Yellowstone . . . . Wendell and Lucie Chapman 107
Animal Life During the Cold Months in the Greatest National Park in the United States

The Netsuke of Japan . . . . Herbert P. Whitlock 121
Beautiful Miniature Carvings from the Land of the Rising Sun

Holland Defeats the Sea . . . . Harold Ward 132
How the Zuider Zee Is Being Overcome by the Hand of Man

Five Hundred Fathoms Deep . . . . Otis Barton 144
The First Photograph Ever Taken of a Fish in the Deep Sea

Microscopes for Amateurs . . . . Julian D. Corrington 146
The Exciting Field of Exploration That Lies Beyond the Magnifying Lens

Down Among the Smokies . . . . F. R. Dickinson 158
A Visit to an American Mountain Range That Possesses a Distinctive Charm

A Unicorn's Horn . . . . Dorothy L. Edwards 168
An Ancient Rhinoceros Horn Now in the American Museum

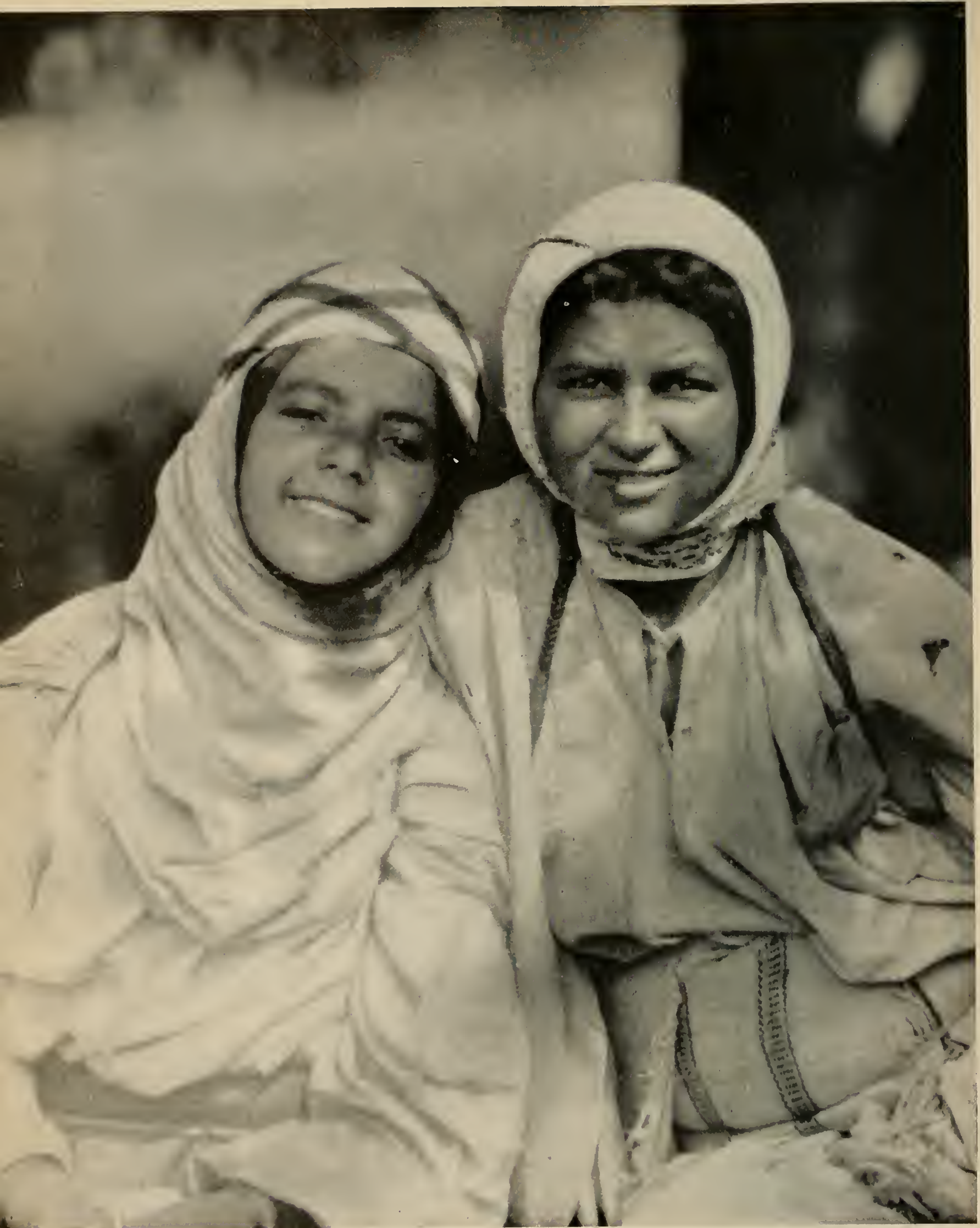
Science in the Field and in the Laboratory 170
Current Events in the World of Natural Sciences

Reviews of New Books 177
Recent Publications for Those Interested in Nature

HAWTHORNE DANIEL
Editor

A. KATHERINE BERGER
Associate Editor

NATURAL HISTORY—Publication Office, 10 Ferry Street, Concord, New Hampshire
Subscriptions should be addressed to 10 Ferry Street, Concord, N. H., or to The Treasurer, The American Museum of Natural History, 77th Street and Central Park West, New York, N. Y. NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership, $2.10 of the annual amount received from each membership being in payment of the year's subscription to the magazine. GEORGE L. ALPERS, Advertising Manager, Advertising Office, The American Museum of Natural History, 77th Street and Central Park West, New York, N. Y. Copyright, 1935, by The American Museum of Natural History, New York



Daughters of the Rif

These two girls are from the Rif fishing village of Tiguisas of the Ghomara, the scene of a famous battle between the Riffian army and the Spanish invaders. They were very shy, and Mrs. Coon, who took the picture, was forced to spend several days and make gifts of dozens of safety pins before they would consent to pose

(See "The People of the Rif")

NATURAL
HISTORY
February, 1935

The People of the Rif

After having bravely maintained their independence for scores of generations, the white tribes of the mountains of North Africa have, within the last few years, been forced to take their place among the subject peoples of the world. It is not impossible, however, that they may still come to play a more important part in the world than they have ever played before

By Carleton S. Coon
Department of Anthropology, Harvard University

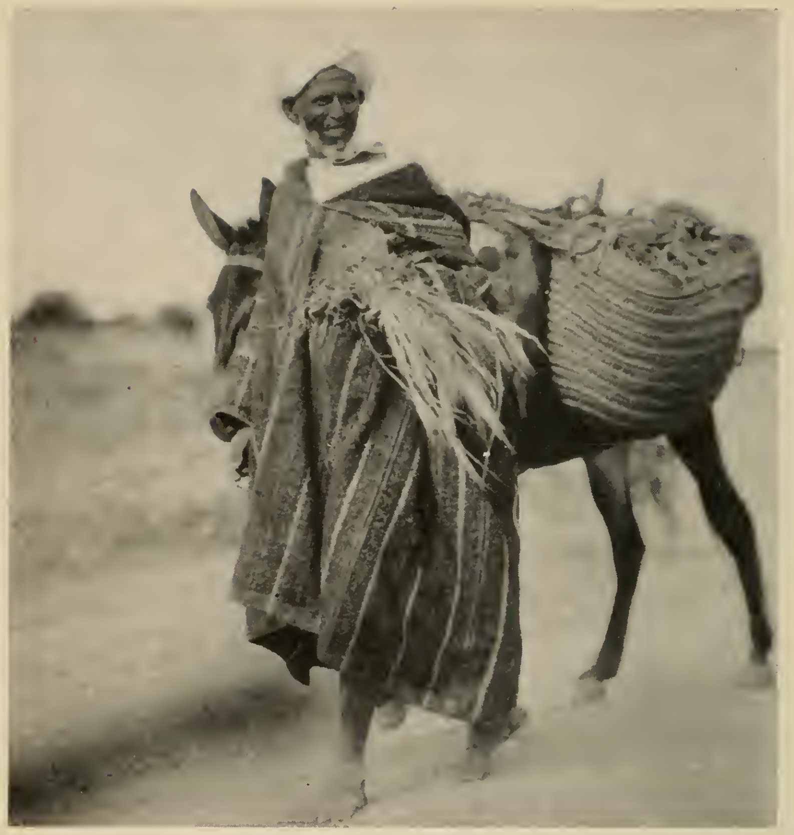
As IS the case with many other brave and spectacular groups of people, much rubbish has been spoken and written about the Riffians. They are often pictured by drug-store novelists and by scenario-writers as lean, hawk-beaked men, shrouded in flowing robes, and riding over the desert on brightly caparisoned horses, leaning down out of the saddle now and then to snatch up whatever ravishing female it may suit the convenience of the narrative to have violated.

As a matter of fact most Riffians are not lean, but broad-shouldered and well filled out; their noses tend no more to aquilinity than do those of most Europeans; few of them own horses, and fewer still know how to ride; and, as a rule, they are not interested in the capture of European females, most of whom would probably not appeal to them.

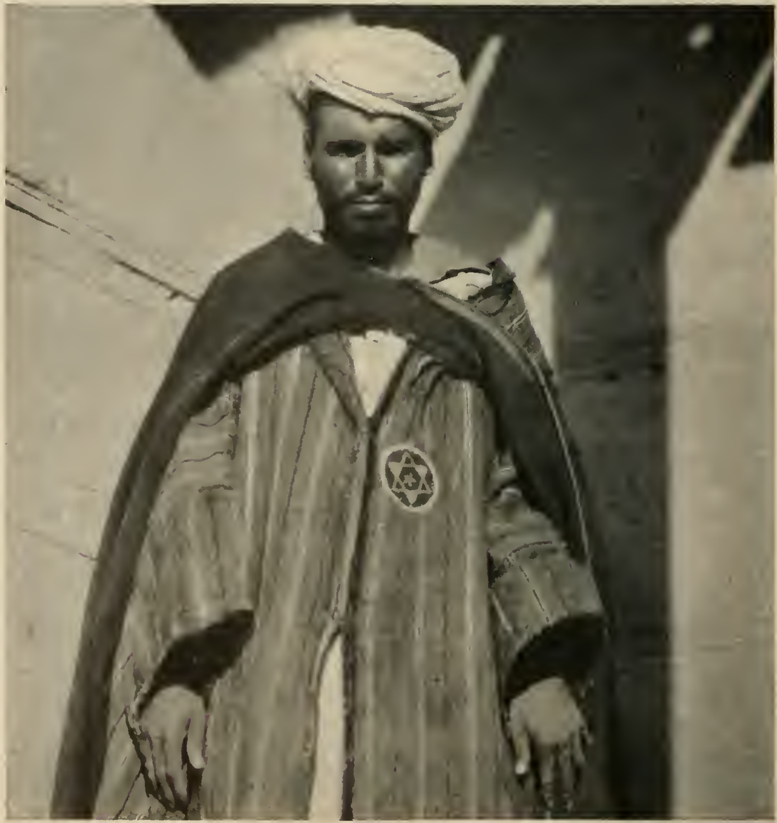
What makes the Riffians especially interesting to science is the fact that so many of them are blond; what makes them interesting to the world at large is that they, a primitive people, situated on one of the world's busiest traffic corners, were able to preserve their independence and keep their rocky soil inviolate until those heartbreaking days of 1926, following Abd el Krim's surrender. How they kept their country as inviolate as Tibet, requires a description of their familiar landscapes and of their culture.

Some of the readers of this article who may have steamed past the northern shore of Morocco may have been reminded of the line in that melancholy Irish ballad: "Where the mountains of Mourne sweep down to the sea." That is just what the Riffian mountains do. From more than one windy pass in the Rif, one can look straight across the Mediterranean to the southern Spanish Sierras. These mountains are not high, for they rise directly from sea level, but they are, nevertheless, rugged and impressive, and form an effective geographical barrier. In only one spot do they harbor a patch of permanent snow, but the abodes of several of the smaller tribes are as snowy in winter as is New England. High up on the slopes stand, or perhaps rather stood, dense forests of cedar, while down in the valleys the torrential streams are lined with trees which bear quantities of olives, almonds, walnuts, figs, apricots, pomegranates, oranges, lemons, mulberries, apples, and edible acorns, to mention the more common fruits. Patches of cork forest provide the western tribes with light and waterproof material for roofing. The Riffians are excellent carpenters, where they can get enough wood, and some of their houses, especially in the west, are well made and artistic.

In the old days the Rif was the home of heavy-maned lions, the last of which prob-

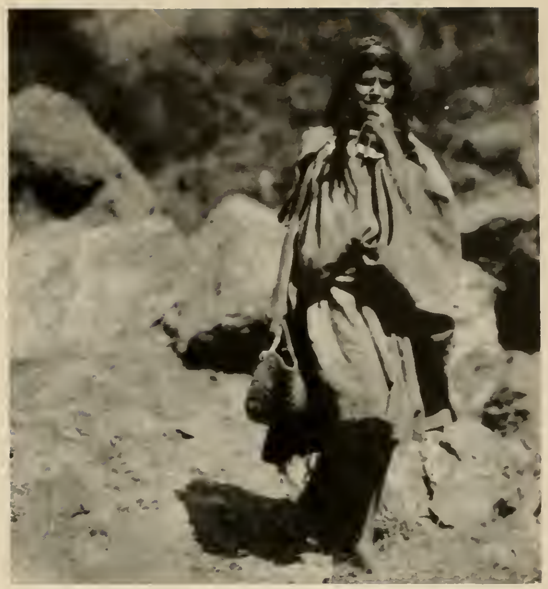


An old man of the Beni Bu Frah, one of the coastal tribes of the Rif, leading his mule to market. This picture shows the typical shwari, *a twilled double panier, which can be slung over the* hallas, *or stuffed packsaddle, in a moment. The Riffians are among the world's most scientific mule packers*

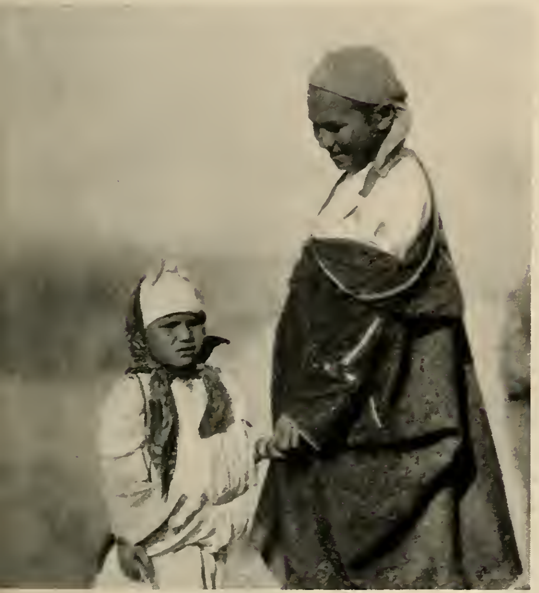


This mokhazni in the Spanish service, a former soldier of Abd el Krim, is a member of the Beni Znassen, a tribe of Berber nomads who inhabit the semi-desert on the southeastern Riffian border

Mountain Dwellers

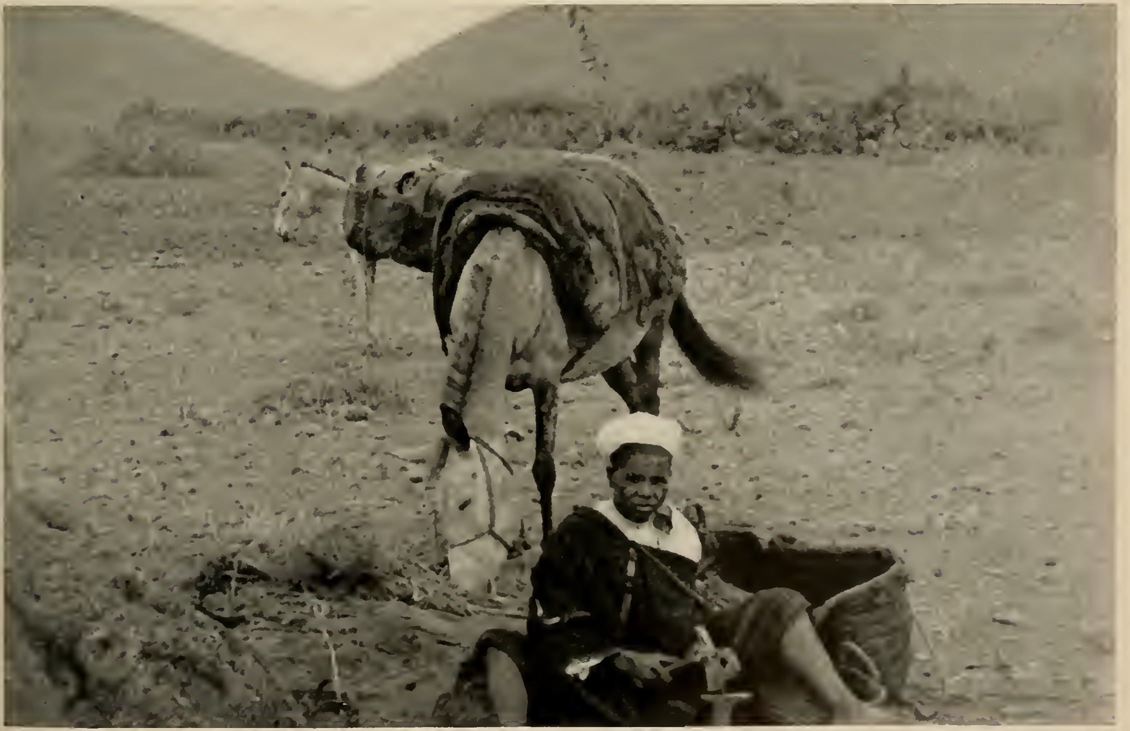


A young married woman of Taghzuth, wearing the thawthat, *the old-fashioned women's garment of the Rif*



Two Riffian boys of the Beni Urriaghel tribe. The larger one is wearing the typical Riffian jellaba, *a short cloak with sleeves and a hood*

A blacksmith working at his temporary anvil outside the market at Ajdir, Beni Urriaghel. In the Rif all blacksmiths are persons of negroid blood, and are not allowed to marry outside their own group



ably died within the past century. Wild oxen, it is said, still survive on the gravelly plain which forms the southeastern border of the Rif. The aoudad once climbed about the peaks, and a very few may possibly survive. The only big game left there today in any numbers is the wild boar, which troops the hills in search of acorns and of gardens to plunder. Although they profess Islam, many Riffians are not averse to dried boar's flesh, and the writer recalls with pleasure the gamy taste of wild ham fed him in some of the higher villages. Hyenas, foxes, and jackals of two varieties are not uncommon, as well as hares, rabbits, weasels, and at least one species of mongoose, and a few varieties of wildcat. Monkeys, which scramble over the rocks just south of the Straits of Gibraltar, do not live in the Rif.

Travel by horse was, before 1926, very difficult; most people did their journeying by foot, while donkeys and mules were used more for burden carrying than for riding. Camels are driven into only the eastern Riffian tribes, where the mountains are lower and slope off gradually into a barren waste, inhabited by nomads, only some of whom are Riffian in language. It is these border tribes, largely atypical, with whom the French had their first fracases, and who consequently are responsible for much of the popular misinformation about Riffians.

The Causes of Their Isolation

Although the environment in which the Riffians live is rugged and forbidding, it alone has not produced Riffian isolation. The character of the Riffians and their manner of living are equally, if not more fully, responsible. The Riffians are essentially warlike and essentially xenophobian. To them freedom is the most important thing in life, and their concept of freedom involves not only the non-interference of foreign authority but also freedom of tribe from tribe, of village from village, and of individual from individual. It is difficult to generalize about Riffians, for each man is a separate entity with his own peculiarities of character and his own ideas. In his type of government this emphasis on individualism is apparent.

The unit of social organization is an expanded family group called the "Vein," including a number of brothers with their wives, sons, sons' families, and unmarried daughters, granddaughters, and so on. This vein occupies one house or neighboring houses, and marriage between its members is forbidden. If one member of a vein is killed, it is the duty of all other members to avenge him, and if one of them commits murder, all others are equally liable to death in revenge. These are not theoretical rules, for in most veins reciprocal murder has taken place at least once in a generation.

Beyond the vein is the "Bone," a clan-like grouping which contains vein relatives who have been relieved of their incest relationship by the death of the oldest generation which bound them together. Thus all members of a bone, saving those taken in by adoption, are relatives, and marriage usually takes place between bone members. Hence a form of distant cousin marriage is usual, or first-cousin marriage where the relationship is only on the female side. This system naturally tends to preserve and accentuate individual family characteristics.

The Organization of the Clan

Beyond the bone is a grouping which may be translated as "Canton," and which consists of some geographical unit, usually a valley, in which several bones have their residence. This canton is rather loosely governed by a council, constituted, by family appointment, of prominent men from each of the bones in the valley. This council meets whenever a breach of the peace occurs, which is rather frequently, and has charge of all offenses short of murder.

In case of murder the councils of the whole tribe, including all its cantons, convene; the spokesmen of the various councils meet in the center of some flat place, while their members form a circle about them. Here the spokesmen deliberate, and determine, after much arguing, both the amount of the fine to be exacted, and the amount of blood money to be paid to the relatives of the deceased. The blood money is intended to assuage the grief of those bereft, and act as a deterrent to reciprocal murder, but it often fails to fulfill this purpose. Many families refuse to accept it, preferring to exact revenge by Mosaic retaliation, in which case there will be no punishment; others accept the money and regret it later, consummating their revenge and paying a fine and blood money in turn. Although the blood money goes to the relatives, the fine, which is usually the larger of the two amounts and often runs into several thousands of Spanish dollars, is divided among the spokesmen who in turn divide it among the council members, who in this manner receive payment for their services.

The Results of Disagreement

It often happens that members of the council cannot come to an agreement; some may be friends of the murderer, others of the victim. Hot arguments ensue, and fighting, and the council splits into two hostile groups entrenched opposite one another. Reënforcements take place on both sides, and soon the tribe is without government. This is the occasion for other tribes to profit. Several of them may meet in one spot and from there invade the territory of those preoccupied by internal battle; the invaders capture village after village, for all are half deserted; they exact fines of increasing size from each village subdued, and take the men of each along with them as forced allies. These allies often are easily persuaded, for they share equally with the others in the fines thenceforth collected. Thus the tribe taken unawares often ceases its internal warring as soon as possible, to patch up a truce and unite against the invaders — but the latter have the advantage of surprise and are difficult to defeat. Thus the lofty purpose of the invaders, to enforce peace, is accomplished by much bloodshed and loss of property; with this background of local custom it is not surprising that the Riffians easily understand the finer principles of France's "peaceful penetration," of Lyautey's prostrate peace.

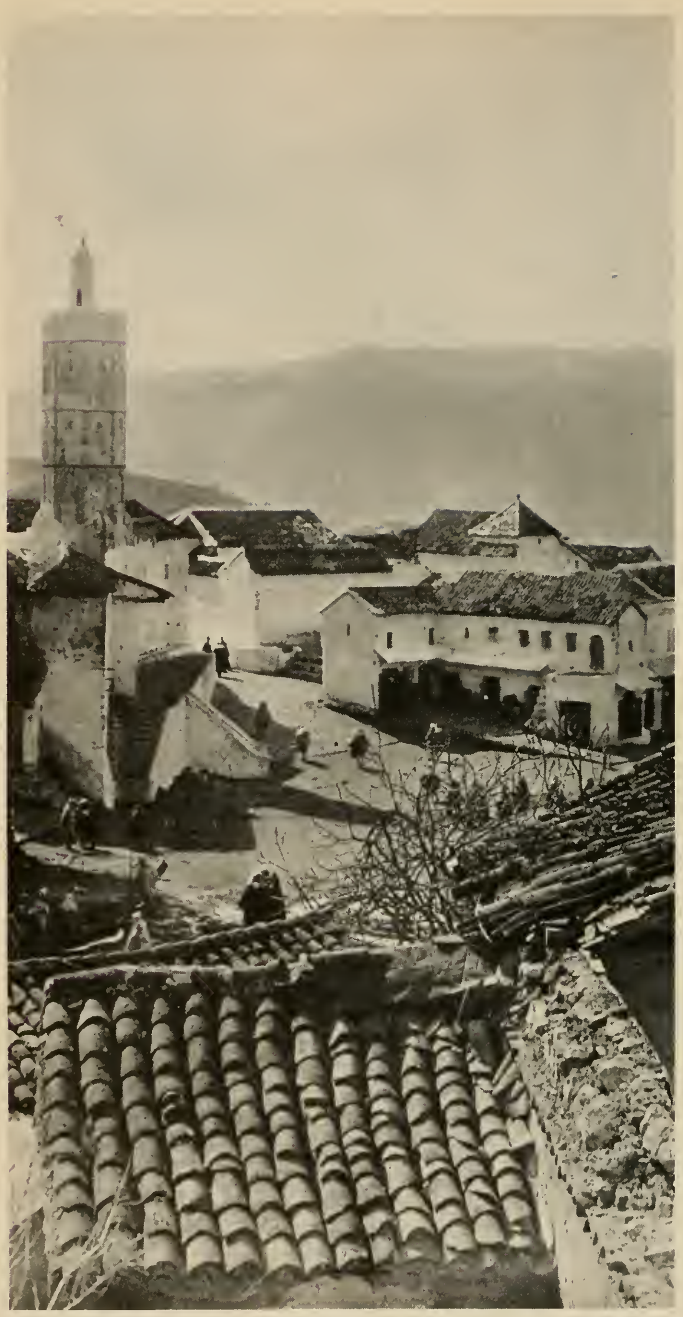
One need not go far to discover the reason for this overdevelopment of internal homicide among the Riffians. The Rif is a small country and chronically holds more persons than its soil can comfortably support. Agriculture has been pushed up the narrow valleys into terraces sometimes no more than a few feet in width; irrigation water must be led for miles through rock-carved ditches, and across canyons in wooden troughs; in the springtime when the barley and rye have been eaten, whole families subsist for months on dried apricots and raisins, while the women comb the mountain-sides for green shoots, especially wild asparagus, and reach into the icy pools along the streams for watercress.

A man who feels himself important may usurp a terrace belonging to a neighbor, or may take more than his share of water from a ditch. There is always tension over land ownership and water rights, and with no effective central government, reciprocal murder springs up without difficulty. On top of this the Riffians have a very keen but boisterous sense of humor; they are forever playing jokes on one another, many of which are as cruel as they are funny, and some of which have been known to cause feuds.

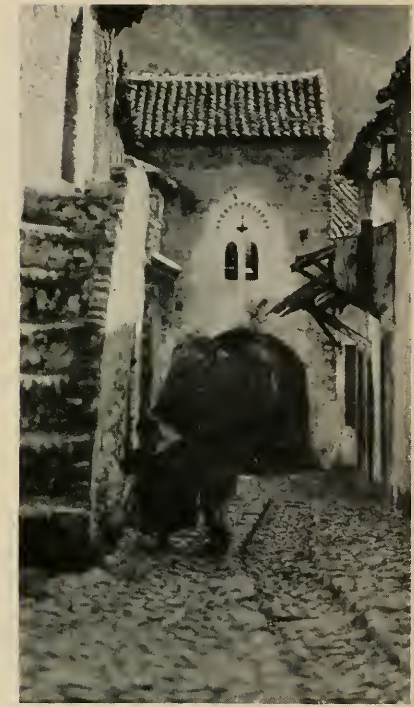
Like many other peoples, the Riffians have a code of sexual morality which is so strict that they cannot all live up to it, hence seduction and illegitimacy give rise at times to blood-letting, while adultery traditionally leads to the murdering and mutilation of the male offender, and nose-snipping and ejection of the faithless wife, both by the betrayed husband. Thus, although the feuds which arise over women are in the minority, they are nevertheless a factor to be considered.

Marriage and Parenthood

The Riffians as a rule marry young, when the boys are anywhere from fifteen to eighteen, and when the girls are about fifteen. They begin producing children as soon as they are able, and continue doing so as frequently as possible, for an early death lurks ever ahead of the father of the new family, and it is well, from their standpoint, to have sons before the father is killed. A youth of twenty slain in a family quarrel may leave three or four children, and these, as well as their mother, are taken over by one of his brothers, in accordance with the ancient institution of the levirate. Hence, in the central tribes, where mountains are highest and terraces are narrowest, polygyny is the



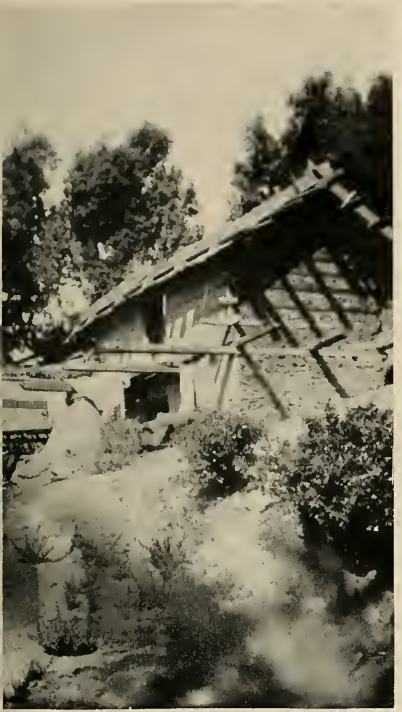
A view of the main square in Sheshaven. The octagonal minaret has no duplicate in Morocco. The broken roof in the right foreground is the work of the American aviators in the French-Moroccan service, who volunteered to bomb the Riffians. On their account the name "American" was not popular in Sheshaven

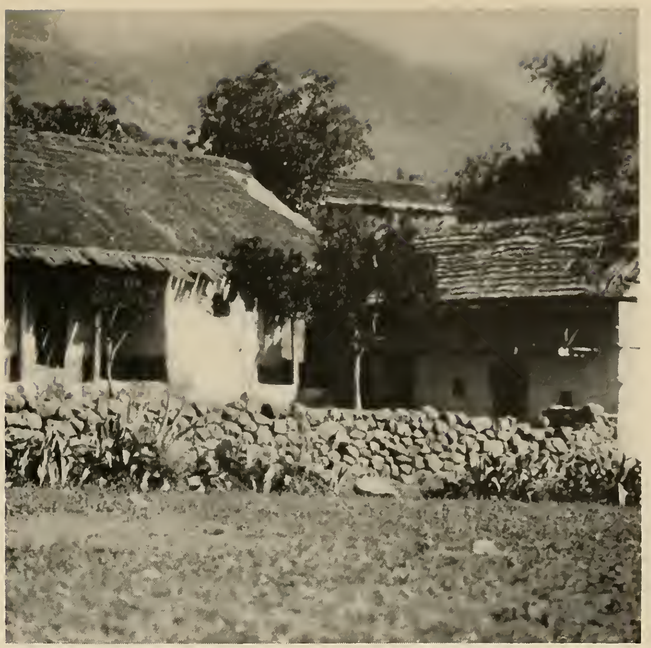


(Above) A street in Sheshaven. This city, in the center of the Jebala country which lies to the west of the Rif, was Abd el Krim's western headquarters

(Right) In the eastern Rif the houses have flat roofs and are surrounded by walls topped with thorny hedges. This Beni Suid house is a good example of the adaptation of house type to climate

Architecture in the Rif





(Above) The main mosque of Ulad el Wartith, in the valley of Taghzuth, with the schoolhouse at the right

(Left) A house of the Beni Bu Nsar, whose name means "The Children of the Christians." These people have a tradition that their ancestors were Christians exiled by some ancient king. They eat pork, indulge in intoxicating grape jelly, and retain many early Christian traditions. They are said to hold Christian ceremonies in great secrecy

rule, and it is not a gustatory polygyny, as among the Arabs, but an economic and social polygyny where every boy needs a father and every woman a husband.

Although few Riffians amass really great wealth, none of them need starve unless all are starving, since several communal institutions provide for all. A man who owns more land than he is able or willing to till may call in poorer neighbors who will work with or for him, and who will receive a generous portion of the produce, allotted by set rule. A man who has been lazy and whose family is in want in the springtime will be forced to sell some of his terraces for food. One out of three cups of oil pressed in the communal oil machinery goes to the mosque, and one to the poor. Products of the land and trees which belong to the mosque go partly to the poor in land who work upon them, and all the windfall fruit, no matter who owns the trees, belongs to the poor. By diligent work a man who has started life with little may die with much, and the indigent son of a rich father may end in poverty. But if a man acquires property, he must also be strong enough to defend it and wise enough to make good alliances and friends, or his work will go for nothing.

Treatment of Trouble Makers

Riffians who are habitual trouble makers, who have been in scrape after scrape, and whose families are not powerful enough to postpone indefinitely the wrath of the tribe, are exiled from the Rif. Sometimes whole families, whole bones or villages, are forced to migrate. Small colonies of these exiles are to be found in many parts of Arab Morocco and even in Algeria. These expatriate Riffians have little difficulty earning a living, for they are the best farmers, and especially the best fruit growers, in Morocco. Some of them have made attempts, usually unsuccessful, to fight their way back to their ancestral terraces; others have gradually lost their identities in the surrounding Arabized population.

The blondism of this people, although often exaggerated, is nevertheless real. If one rolls back their sleeves and looks at the skin which the hot sun of North Africa has not reached, one finds the same pinkish white color, in a majority of instances, which is so familiar in Northern Europe. Even the exposed parts frequently refuse to tan, but burn instead to a chronically raw brick-red. One fourth of the Riffians have freckles, of the type familiarly found in Northern Europe, especially in the British Isles.

Coloration Among the Riffians

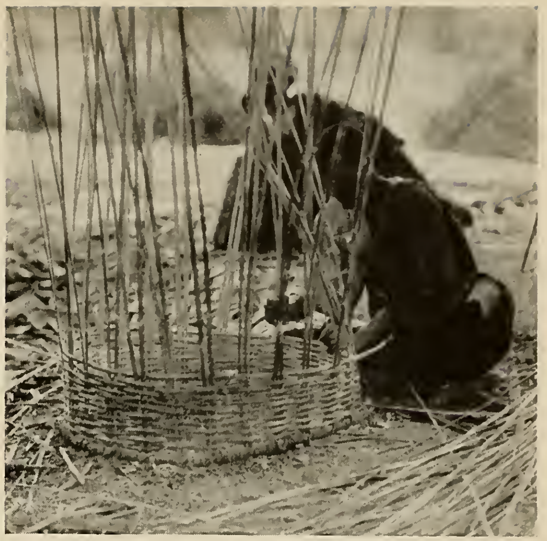
Their head hair is not as frequently blond as people who have seen them imagine, for the reason that the hair usually seen is that of the beard, and the beards of the Riffians are as a rule lighter than the hair on their heads. Less than half have black head hair, but the majority fall into the classes most frequently seen among Americans — dark brown and medium brown. About one Riffian in four has a beard which the average observer would call blond. Only one beard out of three could be called black. The remainder, slightly less than half, fall into the intermediate classes, with strong reddish tinges frequent.

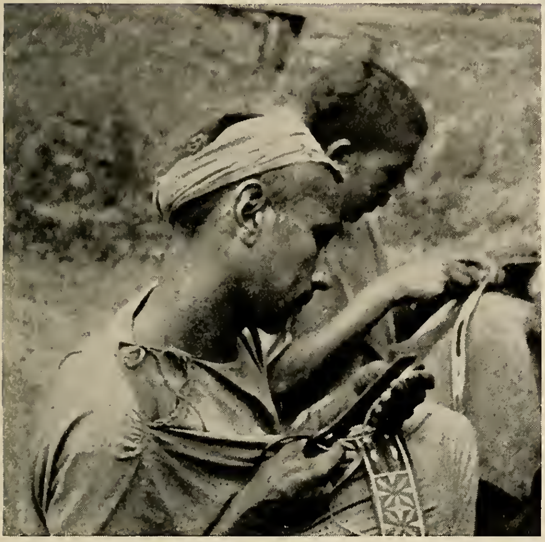
Riffian hair, when blond, is of the golden type; it is never of the dull, ashen hue so frequently encountered among Poles and Finns. Riffian blondism is of the same type as that found in the British Isles, not of that in the eastern Baltic countries. The presence of four per cent of reddish tints in hair color, and seventeen per cent in the beards, marks the Riffians as one of the reddest-haired peoples in the world, just as they are one of the most freckled.

Well over half of the Riffians have eyes which look blue, gray, or green; but which, most frequently, show brownish spots on a lighter background. The combination of bluish eyes under beetling eyebrows, with a blondish or red beard and a ruddy white skin, seen in a large minority of Riffians, is indeed sufficient to give the untrained observer the impression of a pure blond race. As a matter of fact, if observers in all countries used the same standards in observing hair and eye color, it would be seen that few countries outside of the British Isles, Scandinavia, and the nations bordering the Baltic were blonder than the Riffians.

It is apparent from this rapid survey of

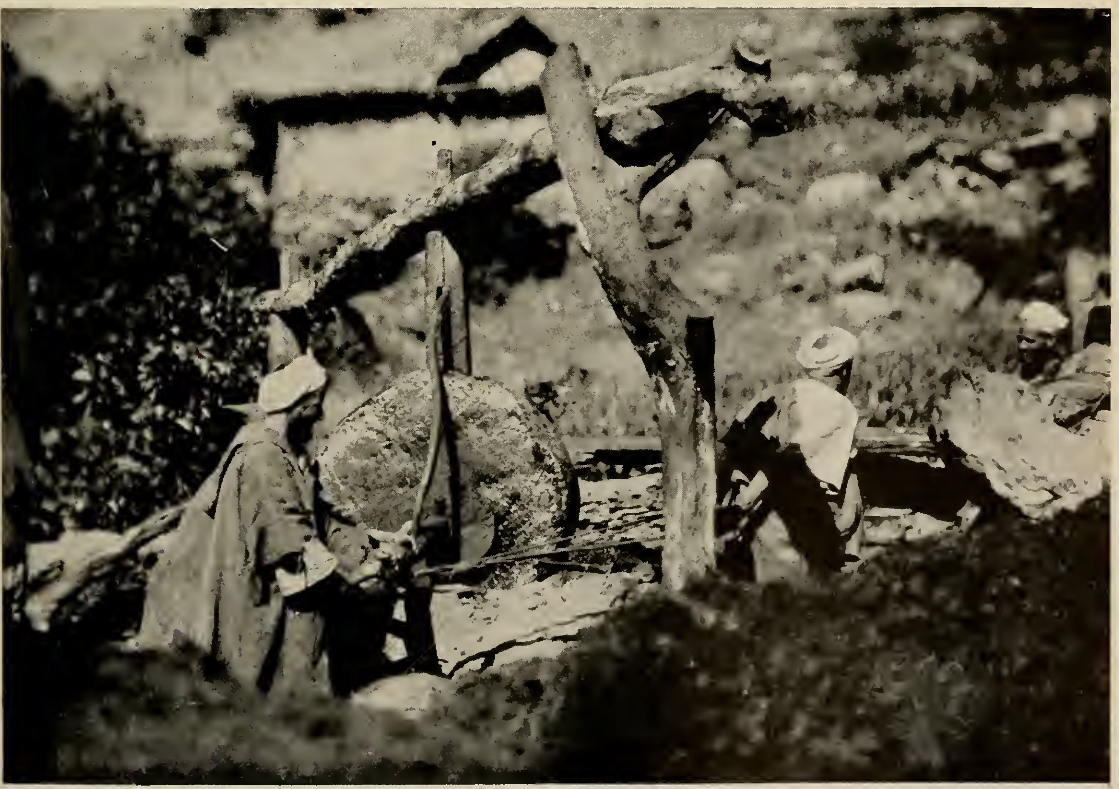
(Below) These Taghzuthi leather workers are embroidering cartridge belts with thin strips of leather, in many colors. Their work is very fine and extremely decorative, and these belts were highly prized by Abd el Krim's soldiers. Some of the cheaper work of these men, in the form of handbags, has found its way to American gift shops and department stores





(Above) In the Vale of Iherrushen, in the northern part of the tribe of Gzennaya, a farmer is making a large basket in which to store his winter's supply of raisins. This region is one of the few parts of the Rif which fall under French administration

(Below) This olive grinding machine of Taghzuth is typical of the whole Rif. One is found in every village, and the heavy stone is turned sometimes by men and sometimes by mule power. The crushed olive pulp is then gathered in baskets and squeezed in a heavy screw press. Each man must take his turn at this grinder, and the schoolmaster keeps a record of the order in which the different farmers may use it



Riffian blondism that these mountaineers are, like most other white people, mixed in race; and in their mixture the Nordic strain plays an important part. If one compares the measurements of head, face, and bodily dimensions of the Riffians who are not brunet with European peoples, one finds that the greatest similarity exists between them and the natives of some of the most isolated mountain valleys of Eastern Norway. There is no question but that one element among the Riffians is Nordic. The great question, however, is how the Nordic race got to Morocco.

Their Unknown Origin

A survey of the eighteen tribes of the Rif and of their near neighbors shows that the greatest blondism and the greatest frequency of Nordic physical type occur in the very center of the Rif where the mountains are most inaccessible and where the culture of the people preserves its most ancient pattern — the conservative nucleus of the country. This region is off the path of the various invasions, Berber and Arab, which penetrated the Rif in protohistoric and historic times.

The Riffians are not the only blonds in North Africa, although they are at present the most numerous ones. The Guanches of the Canary Islands were frequently blond at the time of their conquest by the Spaniards; and a considerable amount of blondism occurs among the Kabyles and Shawia in Algeria. Throughout North Africa, among Arabs and Berbers alike, as throughout Southern Europe and Arabia for that matter, a minimum of blondism pervades all regions yet studied. It is impossible alike to find a blond people of European type who harbor no brunets in their midst, and a brunet people with no individuals showing traces of blondism.

The earliest references to North African blondism come from ancient Egypt. We know that the Mashausha, a blond race, invaded Egypt from the west during the eighteenth dynasty, and their name, as well as their costume, shows them to have been North Africans. The mother of the great Cheops, fourteen dynasties earlier, was pictured in her tomb paintings as a blond, but there is no proof that she came from the west. There is no definite evidence of the presence of large groups of Nordics in Northwestern Europe before the Iron Age, which began, in those parts, at least a millennium after the well pigmented portraits of the Mashausha had been painted.

For these reasons there is no need to suppose that the Nordic strain in the Rif must be the result of some early though unrecorded thrust from Scandinavia, or that history must be twisted to make the Rif the refuge spot of the defeated remnants of the emasculated Vandals. Both the Riffians and the Scandinavians are partly Nordic; both probably derive their somatic similarities from a single source. Where that source was, and how long ago the ancestors of the Riffians split off from it, are questions which the writer, with his feeble science, cannot answer.

The Difficulties of Subjugation

It is not surprising, in a country where only unarmed holy men may travel from tribe to tribe without fear of assassination, that Moslems from outside, not to mention Christians, have been unable to effect a penetration, except with modern military equipment and the expenditure of many years of effort and much loss of money and of men. The natural increase of the Riffians was cut off by their own system of internal warfare; the losses which they suffered at the hands of France and Spain were little greater than what they would have incurred in the same length of time by natural means.

Spain's desire to rule the Rif was the result of a threefold tradition — to get back at the Moors for the centuries of infidel occupation in Spain, to make up for her loss of colonies elsewhere, and to exploit the fabulous and apparently imaginary mines of the Rif. France's desire to subdue the Riffians was chiefly to eliminate a constant source of trouble on the northern periphery of her zone of influence in Morocco.

Subjugating Moroccan Berbers has not been an easy task for either France or Spain, and not altogether a profitable one. Spain alone was unable to defeat the Riffians. The massacre of General Sylvestre's force

Ploughing with oxen under the fig trees at Ajdir. The ploughman is one of the half dozen negro slaves who lived in the entire Rif before the rise of Abd el Krim

A woman of Beni Said carrying home a load of straw on her back. In the Rif most of the agricultural work is done by the men; the women help only during the harvest

In Taghzuth bread is baked in beehive-shaped ovens. On top of this one there is a sheet of cork, used for many purposes, and a typical carrying basket. The little girl, who is the daughter of the chief of the gunsmiths in this mountain valley, is bringing a walnut branch with which her brothers will fan away flies from her father's guests

Two men of the Gzennaya tribe talking it over in the Thursday Market of Ikaroen

Market

In one corner of the market at Ajdir, women sit with their fresh loaves of bread. Immediately after this picture had been taken, the old woman in the center pelted the photographer with stones, and showed surprising accuracy

A jeweller in his earthen booth at the Thursday Market of Targuist. Around each market there is a circle of such booths in which tradesmen display their wares

Scenes

Two small girls riding their donkey home from the market, along the shore at Ajdir, Beni Urriaghel

at Anual, and the Riffian drive eastward to the sea which followed it, ridded Riffian territory, for a time, of Spanish interference. For the first time the world realized that here in Northern Morocco was a body of men which, though deficient in our concept of civilization, was worthy of military notice. The sultans of Morocco had been unable to exact tribute from them, and the Spaniards could do no better.

What the world failed to realize was the profound transformation that was going on in Riffian mentality. For the first time in history, village was uniting with village, tribe with tribe, until a finite power had been created. This transformation was due partly to the situation, in which for the first time in history such a unity was needed — but it was due in even larger part to the personal genius of one man, Mohammed ben Abd el Krim.

Organized Resistance

The first organized resistance to the Spanish was developed under the personality of an older leader, the Hajj Bukkeish, who united the northern Gzennaya, the Beni Amart, and the Beni Tuzin, and who was an equal commander with Abd el Krim on the historic drive from Meidhar to the sea. But Bukkeish was an old man, purely Riffian in training and knowledge, while Abd el Krim had been a judge in Melilla and had studied in Spain. Of the two it was the younger man who gained the ascendancy, who imposed his own ideas of organization, and who inspired, for the moment, the unquestioning loyalty and even reverence of these hard-bitten feud-sniping mountaineers, men who had never before heeded the authority of anything more distant than their own family councils. The Riffians ceased to think of themselves as individuals, and adopted a nationality.

The Future of the Rif

Although the Rif as a nation was short lived, the seed of nationality once sown will take more than a decade of submission to keep it from sprouting. Spain, since her revolution, has begun to realize the potential worth of these men, now that her dreams of mineral wealth have been dissipated; the cruelty with which some of the Riffians were treated at their first yielding has largely given way to a considerate attitude, the employment of many of Abd el Krim's soldiers in the Spanish forces, and a far-sighted leniency in taxation.

The world is full of small remnants of brave and worth-while peoples who have been ground into oblivion by the drab conquest of modern civilization. The Sioux Indians, to quote a single and well-known example, put up a fight equal in quality to that of the Riffians; but the Sioux lived on the buffalo, and when the white men killed off the buffalo, the Sioux's basis of life vanished — nothing remained but starvation or reservations. The Riffians, on the other hand, are farmers, and good farmers at that. They are white men and can take over white men's ways without too much anguish. They are naturally prolific, and their own solution of the increase problem is no longer feasible. If the future does not contain for them the fulfillment of their dreams of separate nationality — and Abd el Krim is alive and still young — they will at least make a worthy addition to the human material of whatever nation absorbs them.

Winter in Yellowstone

Though visited by thousands of tourists every summer, Yellowstone Park is left almost entirely to the animals and the Ranger during the long, cold months of winter

By Wendell and Lucie Chapman

Photographs copyrighted by Wendell Chapman

WINTER does not ordinarily descend upon Yellowstone Park without warning, but threatens with a light snowfall as early as the end of August. Between the first flurries and the real winter storms there are generally several weeks of idyllic Indian summer, with falling colored leaves, warm days, and frosty nights.

The calm and quiet of summer turns into activity, activity everywhere. The tranquil forests become alive with noises. Cones drop as pine squirrels begin their harvesting, chattering displeasure at any intruder who interrupts their work; trees crash in aspen groves where beaver are harvesting for winter food; leaves crackle under active hoofs; saplings break with the strain of rubbing antlers; and the bony clanking of fighting bulls is a sign that the elk are gathering their harems. From the timber by day and from everywhere by night comes a lovesong so birdlike that one can scarcely realize it is a combined love call and challenge of the bull elk.

As winter descends, the geysers are nearly lost in a landscape of white, and the summer beauty of the Grand Canyon is obscured under snow and ice. The white peaks and black forests dominate the scenery as wildlife takes the center of interest.

Strange it is that the greatest wildlife sanctuary in the United States today is so ill-suited in winter for some species. Even the mildest winters are periods of suffering and hunger, and when a very cold one arrives, it descends with such grim cruelty that many of the wild animals are unable to survive.

That the Park area was a last resort for most of the animals now living there is indicated in abundant records left by men who explored the region. Prior to 1880, explorers, naturalists, surveying and hunting parties remarked on the absence of game during even the summer season. Although a limited number of mule deer, wapiti, pronghorn, and moose were reported, a characteristic observation by those going through the region later to become the Park, was that they ran short of provisions due to lack of game. Lewis and Clark in 1804–06 recorded that the abundant game of the prairies practically ceased as they entered a similar mountainous country near the present site of Great Falls, Montana.

But after 1880, those going through the Park remarked on the presence of game. The early Eighties marked the last stand of the animals on the plains. With the encroachment of the settler who fenced off the natural feeding grounds, the stockman whose herds cropped off the range, and the rifleman who finished what starvation did not, the safest place for the wildlife to go was to Yellowstone Park, with its climatically inhospitable winters. About this time bison disappeared from the plains and some appeared in the Park. A few individuals of most species of the West managed somehow to find and recognize this sanctuary, and most of those species have been able to survive. Some are naturally fitted to withstand the severe winters, some have adapted themselves well to their adopted land, others are hanging in the balance, while a few have disappeared from the district. Naturally the Park affords drama during the cold winters and deep snows.

The lowest valleys in the Park are a mile or more above the level of the sea, and the grazing or browsing areas within these constitute a very small fraction of the entire Park area. When the deer, wapiti, prong-

Winter

The museum in Morris Geyser Basin. The mounds in the foreground are trees bent over by the accumulation of powdery snow that congeals from the geyser spray carried by the wind

Most shelter cabins in Yellowstone Park are located off the trails and are hard to find in the dark or during the occasional blizzards. The doors of these cabins are never locked during the winter, and they are kept well provisioned

The large photograph above is of the Mammoth Hot Springs Terraces after the first snowfall of early winter. Later in the season they become covered by a solid mass of white, save for a few hot-spring drainage areas

Reigns

Skiing over the Mammoth Hot Springs Terraces is a favorite winter sport in Yellowstone Park. The limestone formations are visible where the hot waters trickle even during the coldest weather

TERRACE
TRAIL

horn, bighorn sheep, and bison are forced down by the snows from the abundant summer ranges of the high plateaus and slopes, they concentrate on the inadequate lower valleys and soon crop off the feed. During even the mildest winters, the uplands are covered with snow and the animals must descend.

Elk form the greatest numbers on the winter range, there being some 15,000 in the Park, while 3000 is considered a more proper limit. Because of the inadequate winter range they are fed hay in case their natural range becomes exhausted or locked under crusted snow. Hunger forces them, against the dictates of their natures, to come on to the fields of the two elk ranches while the hay is being scattered, but they do not become tame. Once feeding starts, they hang around in near-by timber to await the daily dole, and they will well-nigh starve before getting out and rustling again until spring. Because of this tendency to lie down and let the government provide once it starts, the authorities hope to be able to replace the feeding of hay by planting forage crops which will give a yield superior to the native grasses.

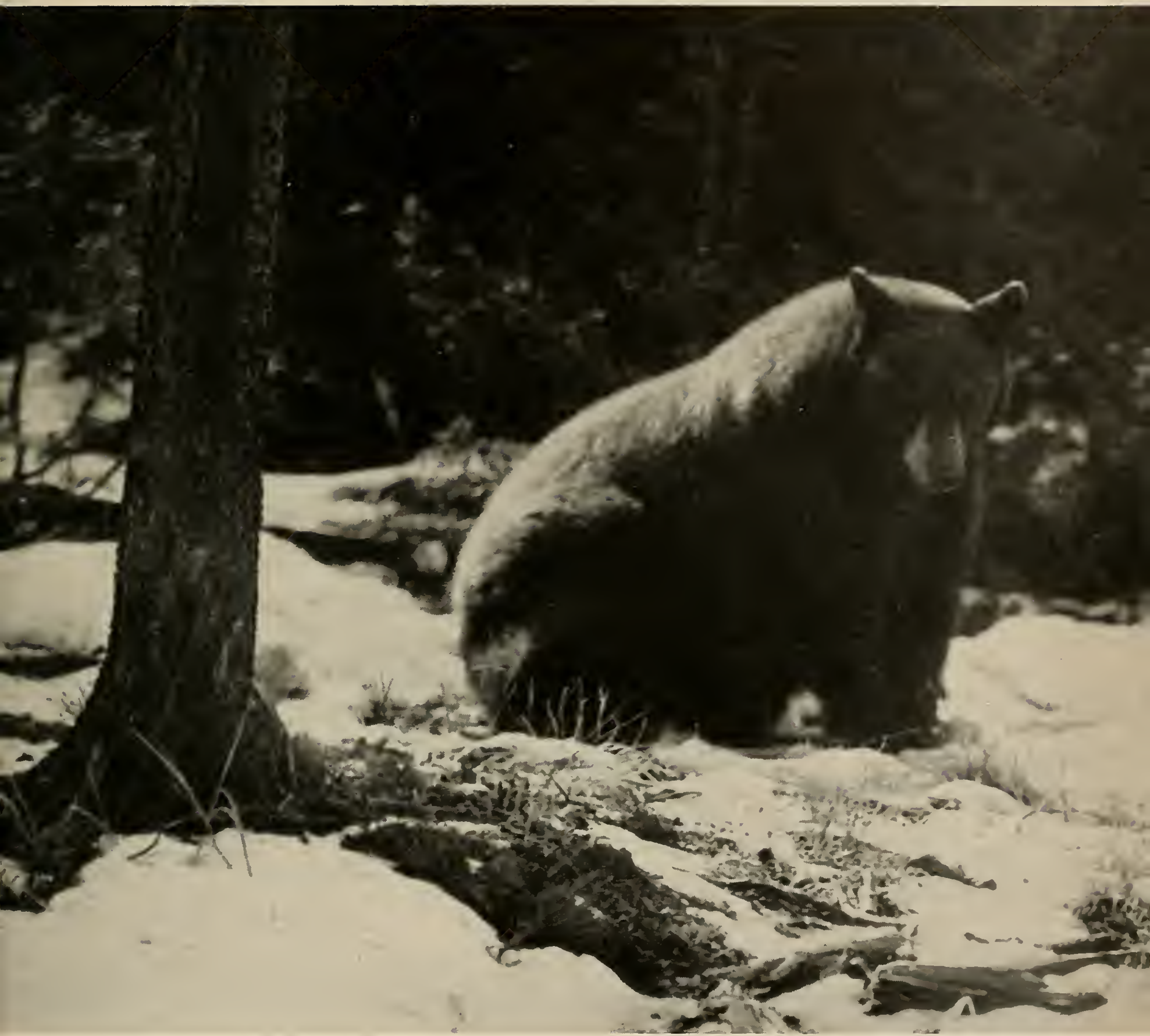
Moose

One large animal which does not come down to the lower winter ranges is the moose. His long legs are well adapted to taking him through deep snow. Ranger F. Sheldon Dart reported having seen moose traveling quite easily through fifty-four inches of snow in the Upper Yellowstone Valley. The principal winter diet of the moose being willows and shrubs, he is not confronted with the problem of digging them out, because they grow to a height of ten feet or more in his valleys. Unless a thaw causes a hard crust to form on deep snow in the spring, the moose has little to fear from enemies. Harry Trischman, who has seen more of Yellowstone Park than anyone else now in its service, reported having seen a grizzly late one spring overtake a moose. The deep snow was heavily crusted so that the bear did not break through, while the moose did. Under such a handicap the moose was soon caught and killed. Such cases, of course, are rare.

From October until spring, the moose has an ugly disposition and several rangers on patrol have been charged. There are many stories of moose having forced rangers with skis or snowshoes on to climb trees, but investigation invariably reveals in each case that although the moose did make the ranger climb a tree, and kept him up in the cold for a couple of hours, the footgear was first removed.

The most spectacular animals formerly of the Great Plains, the bison or American buffalo, drift down into the Lamar Valley from the summer range on Mirror Plateau, over a mile and a half above sea level. Cowboys then drive them into the corrals at the Buffalo Ranch, where good specimens are selected for shipment to establish other herds, weaklings are butchered for the Indians, and the remainder are released into the valley, where they remain during the winter, daily following the hay-sled. Although the largest of our native animals seem tame while being fed, they always retain the instincts of the wild beast. Occasionally a fence around a haystack is broken down and buffalo enter. Elk who graze compatibly on the open range within a few yards of the buffalo come through the fence to crowd in at the stack. A buffalo, often without warning, impales an elk before it can get out of reach. Whenever a stack is so entered during the night, several elk are found gored. Horses also have been killed in past years before the authorities learned it was not wise to allow them to occupy the same fields with the buffalo. And the buffalo does not draw the line at elk and horses.

An illustration of what he may do to man occurred several years ago when Bob LaCombe was Keeper of the Ranch. An old bull, outcast from the herd, came to feed near the barn during the winter. Daily he ate the hay which was thrown to him, becoming apparently tame. One day Mr. LaCombe went to the barn, passing within a few feet of the bull, who continued eating. A few moments later one of the young assistants followed Mr. LaCombe into the yard, and was about to pass, when up went the bull's tail, steam shot from his nostrils, and on he came, charging like a demon.



Ready for Hibernation

Fat and ready for hibernation, this fine black bear is about to disappear for the winter. It is now a well-established fact that even in the midst of his hibernation period he can be awakened easily and often stands ready to protect himself against attack

Animals of

(Left) As winter comes, the mule deer follow the trend and migrate to the lower and less exposed levels

(Right) Extremes of weather often force the elk (wapiti) to respond to the call of hunger and come on to the ranches, where hay is thrown out for them

(Below) Mule deer about Headquarters at Mammoth Hot Springs have become expert at knocking off the lids of the garbage cans in their hunt for food

the

Park

(*Above*) *When the early snows cover the higher plateaus, the herds of buffalo migrate into the more protected reaches of the Lamar Valley*

(*Below*) *Even bighorn sheep become reasonably tame in Yellowstone Park. A band of ewes and lambs are shown here pawing the snow from the winter pasture slopes*

Rushing for his life, the young man climbed the fence. A horn ripped one trouser leg and slit the skin of the man's thigh as he leaped over to safety. Had the bull taken it into his head to charge three or four minutes earlier, when Keeper LaCombe was passing, a tragedy would have resulted, because Mr. LaCombe was an old man and would not have been able to get over the fence as did his twenty-five-year-old helper.

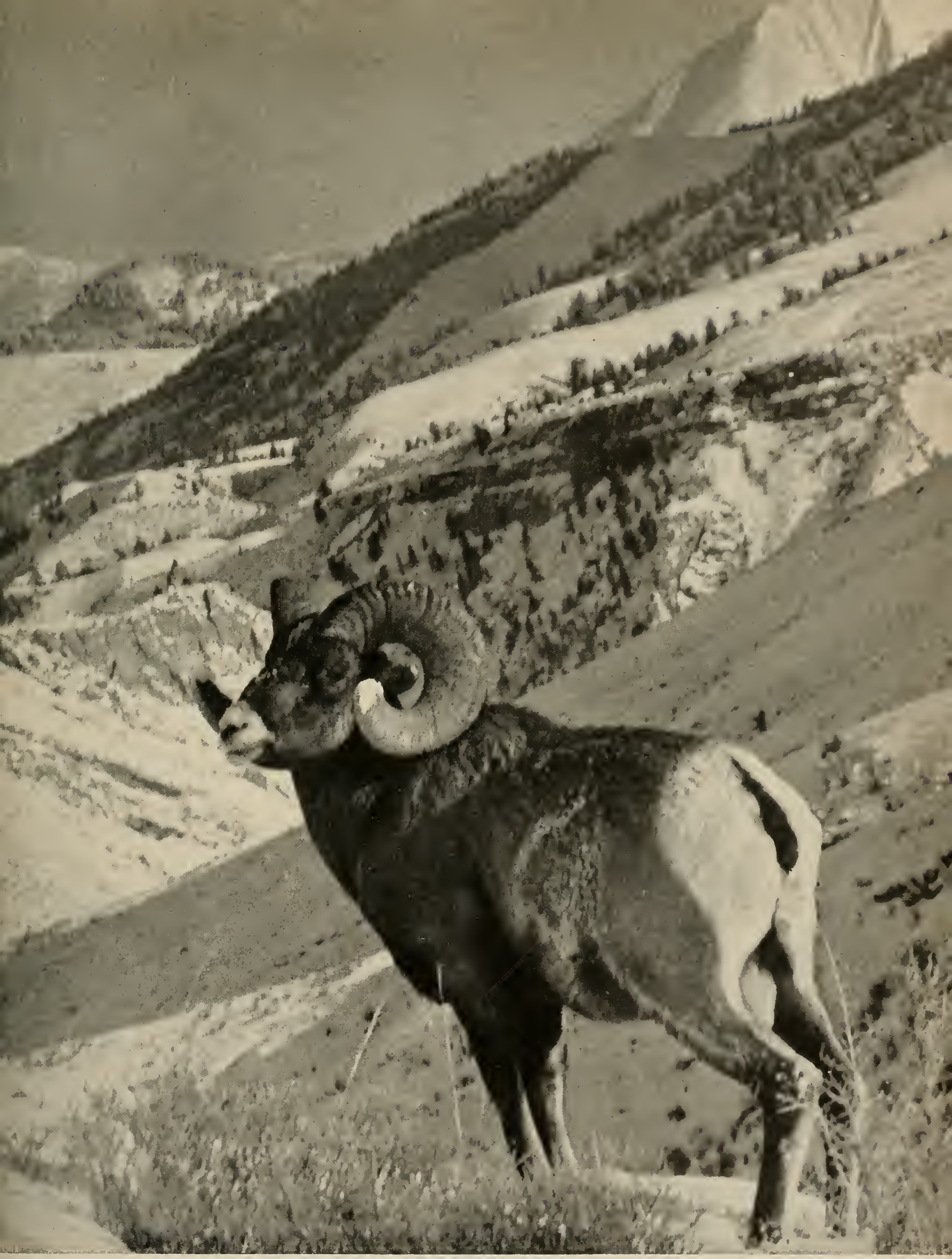
The Bison of Pelican Valley

Each winter a few buffalo elude the round-up, coming down to the Ranch later for hay. A few others drift in the opposite direction to Pelican Valley, 7800 feet above sea level, near Lake Yellowstone, and there must winter as best they can. Although they occasionally paw the snow off the grass, buffalo usually root into it much like pigs, according to Mr. Joe Douglas, for many years Keeper of the Buffalo Ranch. He reports he has seen them in the spring with faces cut and bleeding from rooting into heavily crusted snow. Their beards become matted with ice, and, during their rooting movements, these beards brush the snow somewhat like brooms. The buffalo further resemble pigs in the grunts which are emitted by old and young, male and female, alike. Mr. Douglas said he has never heard them make any other vocal sound.

A few hundred head of pronghorn or American antelope, those elegant plains neighbors of the buffalo, are forced to winter in the Park, because their original prairie ranges have been settled. They are unable to cope with severe winter conditions so well as the larger animals. One day during a storm we came upon a dozen lying in a sagebrush pasture. Near by was a grove of trees which would have afforded shelter, but they preferred the open, evidently in order that they might have a clear get-away in case of danger. Snow had drifted over them until they looked like mounds in the landscape. At our approach black slits appeared as eyes, and as their heads went up in alarm, an inch-thick cloak broke around their necks. Leaping to their feet, with tattered white mantles sifting from their backs, they sped away into the blizzard. The deepening snow, which retarded speed, meant tragedy for the antelope. During severe blizzards predators as well as victims remain inactive. When the storms clear, all come forth in search of food. The night following this storm, coyotes ran an antelope buck into a mesh wire fence which was placed on the northern boundary of the Park to keep the animals within the sanctuary. His prong horns hooked into the wire and, while he was tethered, his pursuers ate him alive. The fence has since been removed.

In addition to other killings in which deep snow alone was the necessary handicap, a unique tragedy occurred early in the winter. A young antelope doe was hit by an automobile which broke one hind leg at the heel joint; the haunch of the other was skinned by the impact. She ran out of sight, and a search by the driver failed to locate her. Hearing of the accident, we took up her trail the next morning and found that every hundred yards or so she had lain down in the snow and then risen from the blood-stained bed to hobble on. Her dangling leg dragged a troughlike track through the snow as blood also marked the trail. Within a distance of less than a mile she had bedded down six different times during the night. Finally she swam across the Gardiner River, where we discovered her wet and shivering lying on the bank. It was early in the season for coyotes to be on the lookout for big game, the snow being light and other food abundant, but they live by their wits and are not long in locating such unfortunates. Upon bringing a ranger to put her out of her misery, we discovered that she had moved on.

We took up the trail which led into some broken ground, the kind ordinarily shunned by antelope. She had hobbled through this, walking on the bone of the injured leg for half a mile. In several places she had struggled and fallen back, while climbing over banks. A fresh coyote track joined her trail, and a few yards farther on dirt was kicked up on to the snow where the antelope had whirled and plunged. Coyote tracks looped in a lace pattern about those of the doe, tufts of yellowish hair were dropped on the tracks and the crimson stains on the snow increased. After follow-



Bighorn

The horn tips of this monarch of the bighorn herd are broken and frayed from fighting many battles during the mating season

(*Above*) *These bighorn sheep have been driven off the higher mountains by the deepening snow, but find it possible to exist at lower altitudes*

At the left a beaver is shown gathering aspen tree limbs for winter storage. Below are the tracks of a marten in the snow

(Right) This rabbit has changed his coat to one that will synchronize with the snow, but, before the snow falls, he has become more obvious to the eye

(Below) A ranger on patrol fords Yellowstone River. In few districts of the park can horses be used during the prolonged winter

ing a few hundred yards of this evidence, we heard the bleat of the doe. Peeking over a bank into a dry wash, we saw a coyote dashing about like a matador, tearing bits of flesh from the skinned haunch. The antelope, crippled and trapped in the gully, was able only to whirl and bleat. Obtaining a picture would have required stalking closer and prolonging her agony. The ranger shot, first the coyote, then the doe. What a pity the speeding motorist could not have seen the fate of that beautiful creature. With the improvement of the highways in the Parks and the inevitable increase of speed, dozens of animals are injured or killed each season.

Mule Deer and Coyotes

When the snow deepens to two and a half feet or more, mule deer also provide meals for coyotes, who travel easily over snow. In a valley near Hellroaring at least eleven deer were devoured in a few days following a heavy storm. Tracks showed that the coyotes, when their paws started to sink, squatted on flattened legs, using them somewhat like skis, as they crawled over the surface on their bellies. In one place tracks following those of a doe indicated that two coyotes had slowly pressed her forward until she worked to the edge of the frozen Yellowstone River. Most of the snow had been blown from the ice and no tracks remained thereon, but what happened is indicated by the fact that a few feet from where the deer trail — flanked on either side by that of a coyote — led on to the ice, her partly devoured carcass lay. Backtracking her trail failed to reveal any indication that she was not in perfect condition, nor did it indicate any sign of a struggle before she reached the ice. Apparently the coyotes had maneuvered her on to the ice, killing her the moment she slipped. Coyotes eat mice and bugs when they are available, but when winter comes and small food is scarce, they turn to larger game.

Several dozen deer have found almost complete security by spending the winter at Park Headquarters at Mammoth Hot Springs. Coyotes seldom come near dwellings and the deer graze on the lawns, browse on whatever shrubs are not fenced from them for the winter, or they knock off the garbage-can lids and rummage around for many kinds of scraps they relish. Then, too, they have learned to "panhandle," and as park employees emerge from the government mess, the deer stand near the door, anticipating handouts. For several years the same deer with their offspring have been returning, and for a while it was feared that inbreeding might weaken the strain, but this year late in November several wild bucks came in for the mating season, and put the tame bucks out of the running. The wild ones learned quickly from the action of the does that they were safe when people walked near by, although most of them left as the breeding season came to a close.

When the animals are not foraging, they spend much of the time resting. They lie in the snow and their beds show a fortunate providence of Nature. If an animal lies for several hours, the snow packs, yet it shows practically no signs of having been melted by body heat, so thorough is the insulation of the coat. If heat escaped in sufficient quantities to melt the snow beneath the body, the animal might freeze down during cold snaps of thirty to sixty degrees below zero.

Fur-bearers

However, Nature in her providence is not always kindly. In the matter of protective coloration seasonal and coat changes are not always synchronized, particularly when winters are mild and snows come late. At such times the rabbits, both Jack and snowshoe, are white spots on the drab landscape. Although Nature seems to have betrayed them, a partial compensation for being so conspicuous lies in the fact that one of their enemies, the weasel, has likewise become white and is more easily seen.

If one skis into the interior of the Park, he may see some of the valuable fur-bearers. Beaver, which generally remain in their lodges except for short dives to the storage pile or the refuse spot, and who ordinarily reveal their presence only by the steam which arises from ventilation holes in the roofs of their houses, during the cold weather, sometimes appear along the open streams which drain from thermal districts.

The blowing spray from the geysers collects in fantastic mounds about the trees in their lee, some of them being bowed to the ground by the congealed vapor

Doctor Chapman beside the warm Gardiner River when the temperature was 30° below zero, Fahrenheit. Frozen vapor heavily weights the branches of the trees and shrubs

Wherever hot springs in the bed of Lake Yellowstone keep the ice open, the traveler will likely find otter sitting on the edge, sunning themselves or eating fish. Upon approach, they will growl as they slip into the hole and disappear, the water lapping smoothly around their cone-shaped tails.

Tracks of the pine marten and their miniature counterpart, those of the weasel, are frequently seen because these animals are active on land and are tireless travelers. The snow over meadows is often crocheted with tracks of weasels which disappear into small tunnels and reappear on the surface as they carry on a restless search for mice. One winter two rangers came upon fresh marten tracks as a snow storm was breaking up. They took up the trail in order to learn something of the animal's range. After following the trail for about fourteen miles that day, the men had to abandon it, never having come within sight of the marten.

A Pine Marten Serenade

These fur-bearers often come to shelter cabins for bits of food and will accept anything from jelly to meat. One midnight in February, while on a ski trip into the Park, one of the authors of this article was awakened by a pair of pine marten which broke into a serenade like that of cats, except that the tone was a little lower in pitch and the serenaders far less stationary. Under the floor, up the log walls, over the roof, down a corner, out through the forest, up and down one tree after another, back to the house, and over the circuit again and again went the pair, easily traceable in the dark by their constant racket. Even though they did sound much like back-alley cats, the thought that one was being serenaded by such rare and gorgeous creatures was adequate compensation for the lost sleep.

In contrast to the hard struggle of most of the hoofed animals is the easy winter life of the bear. Grizzlies den up when permanent snows come to the high country about October, and the black bears go in when permanent snows cover the lower country, a month or six weeks later. The old idea, however, that the bear spends the winter in a state of torpor is being dispelled. During the winter of 1932–33 a crew which was encamped at the Golden Gate to construct a highway tunnel made some experiments on black bears which had denned near by. The life of these bears was not so easy that winter. When rangers were not around, the laborers threw rocks and rolled bowlders into the dens. The bears growled, came out bristling, woofed at the intruders, often charged a few steps, then retired. Sticks of dynamite were also tossed into the dens. The bears came out immediately after the explosions, growling and confused. After waiting outside, apparently for the fumes to disappear, they returned to their troubled beds. Such disturbances were kept up off and on during the winter, and the laborers told us that the bears never showed any evidence of having sunk into a torpor, characteristic of true hibernation. And that was during the extremely cold winter, when a record low for the United States of sixty-six degrees below zero F. was reached in the Park. Similar observations have been made by rangers stationed at Old Faithful, where black bears den up under buildings. Whenever the rangers have looked in, the bears have greeted them with open eyes and growls, showing that they were very much awake. Because of the inaccessible places where the grizzlies den, and because of the probable treatment an intruder would receive, few experiments have been carried on with them. Those who are in districts affording such opportunities, prefer to let the other fellow find out for himself.

When winter has run its course, many of the animals appear to have reached the last stage of decrepitude. Bones poke up beneath sagging hides, and the backs of the deer and elk look badly "moth-eaten" by the parasitic grubs which fester in their backs and blotch their coats. If green grass sprouts forth suddenly in abundance by a pathetic irony, many of the grazing animals that have been barely able to pull through, "spring-kill" on the feast. Of course, this ill wind brings fat pickings for the predators. Such is the tenacity of life, however, that the majority of the wild creatures pull through to enter an easy season of abundance in which to bear and rear their young and to recondition for the following winter.

The Netsuke of Japan

An account of certain miniature Japanese carvings featuring the mythical stories they tell

By Herbert P. Whitlock

Curator, Department of Minerals and Gems, American Museum

In Japan, where the art of carving both beautifully and delicately in ivory and wood has been carried to such extraordinary perfection, a particular type of carving is unique. The Japanese costume is devoid of pockets, with the result that each person usually carries a handsome bag or detached "pocket" which he attaches to his girdle by means of a "netsuke." This decorative piece, usually of ivory or of wood, is almost invariably a little work of art, and the specimens that illustrate the following article are from the Drummond Collection which recently has been put on display at the American Museum. The word is not pronounced as it is spelled. An approximation of the Japanese pronunciation might be written phonetically as follows: Netski.

—The Editors.

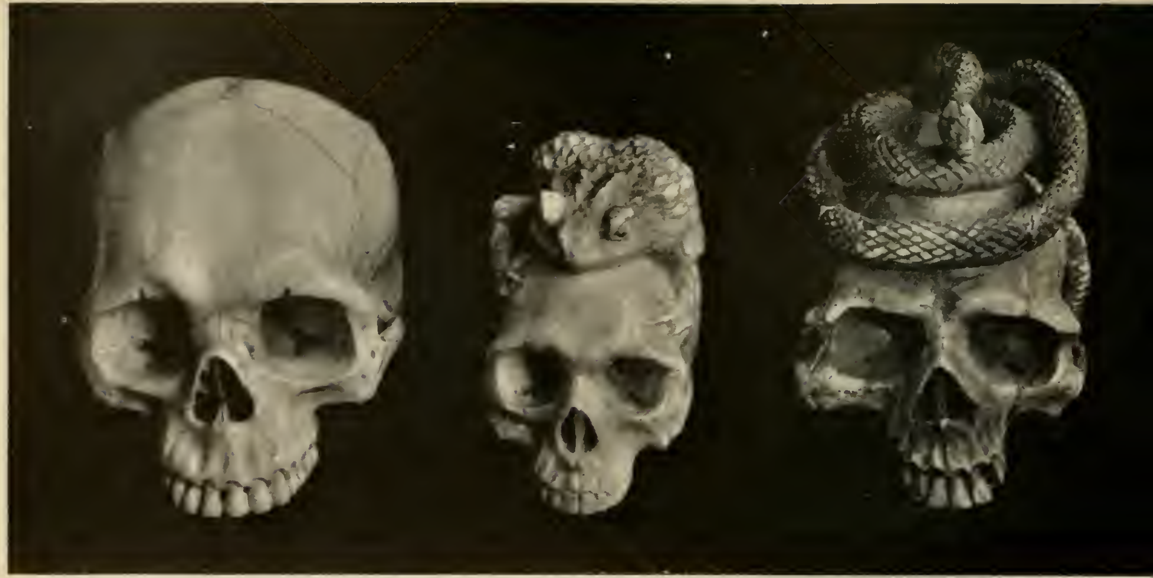
THE Japanese carver in ivory practices an art which is in many respects essentially different from that of his brother craftsman, the Chinese lapidary who works in the harder mediums. His is a handicraft allied in material and technique with that of the wood carver, and, indeed, he often resorts to wood and handles it with the same facility with which he uses ivory.

Unlike the Chinese carver of jade, whose tools are few and simple, the Japanese ivory carver produces his small, realistic works of art with the aid of a multitude of knives, burins, gravers, chisels, drills, files, and saws. A full set of these implements contains upward of fifty pieces, including right-handed and left-handed burins, whose purpose would be obvious to a golfer who uses a left-handed club when the golf ball lies close to the right side of an obstacle, such as a tree root.

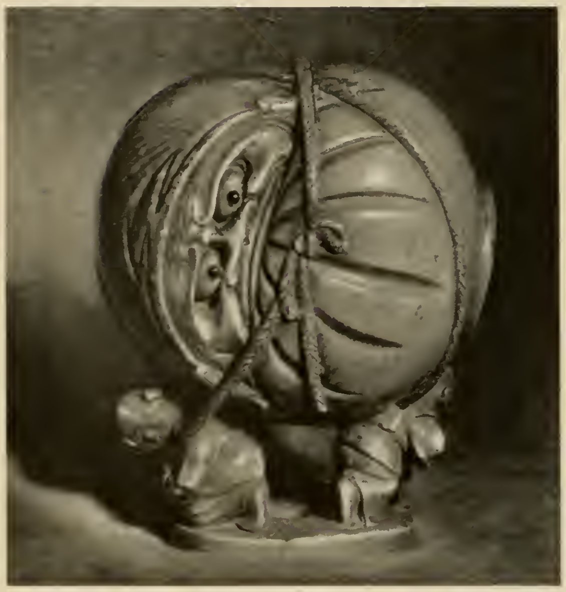
Such an array of carving paraphernalia has rendered possible a perfection in the representation of detail which in many cases is little short of microscopic. So meticulous indeed is the work of the Japanese ivory carver, that it often includes a completeness of rendition undreamed of by an Occidental artist. One of the pieces in the Drummond Collection, for instance, depicts a huddle of twenty mice which not only are reproduced to the last hair on the exposed or upper side, but whose feet and claws, not to mention the articulations of the tails, also are faithfully shown on the *under* side, which is usually hidden from view.

Ingenuity as well as skill is shown by these clever craftsmen, as when they represent a monkey that is capable of running in and out of a hollow log, or an ivory toy representing a street actor that is actually capable of changing his masks by means of the flick of one's finger.

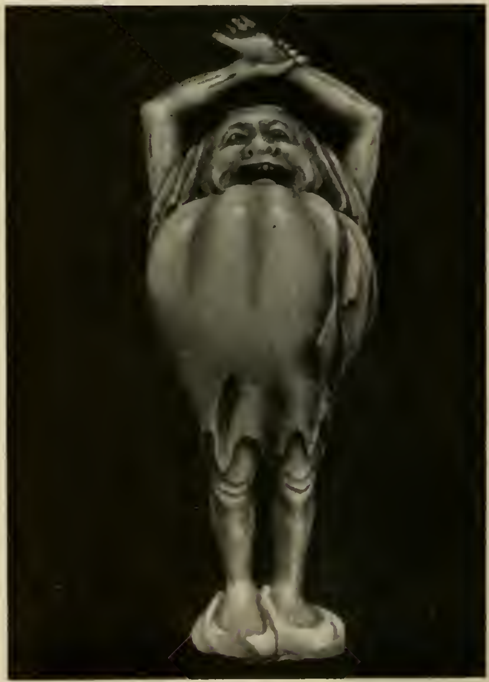
Much of the finest ivory carving in miniature pieces takes the form of netsuke, the buttons or bobs that terminate the cords to which the various girdle appendages are attached, and prevent these cords, when passed through the girdle, from slipping out again. These netsuke, although varying somewhat in size, are, from the nature of their use, small and compact, and are of almost infinite variety in design. There is hardly a legend or folk story known to Japanese legendary lore which has not at some time or other inspired the design of one or more of these clever little carvings. They are dramatic, they are philosophic, and very often they are highly humorous,



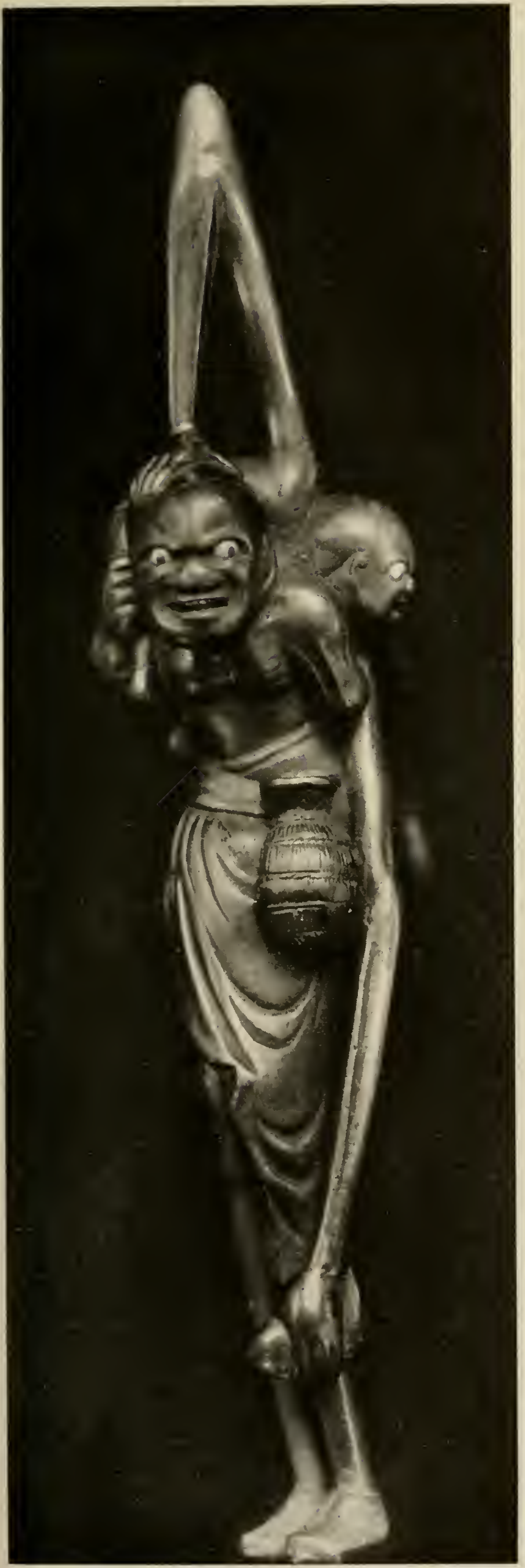
Skulls are very popular subjects for netsuke among Japanese ivory carvers. The decidedly macabre sentiment which attaches to a medicine box (inro), such a forceful reminder of mortality, is thoroughly consistent with an art that emphasizes the grotesque and the abnormal



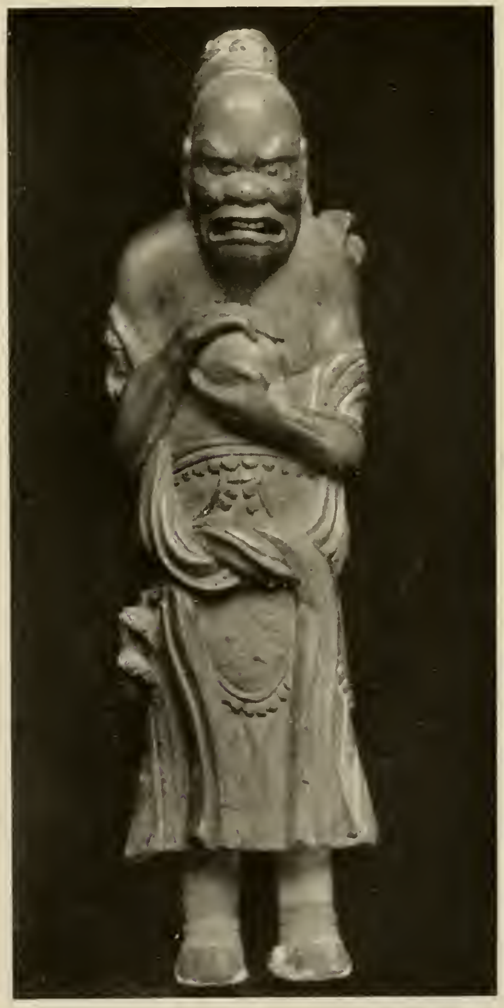
The legless Daruma is a favorite toy among Japanese young people, and is often reproduced as a snow man by Japanese boys. The little netsuke above does not, however, depict such a snow man, but a toy Daruma of heroic size made of papier-mâché



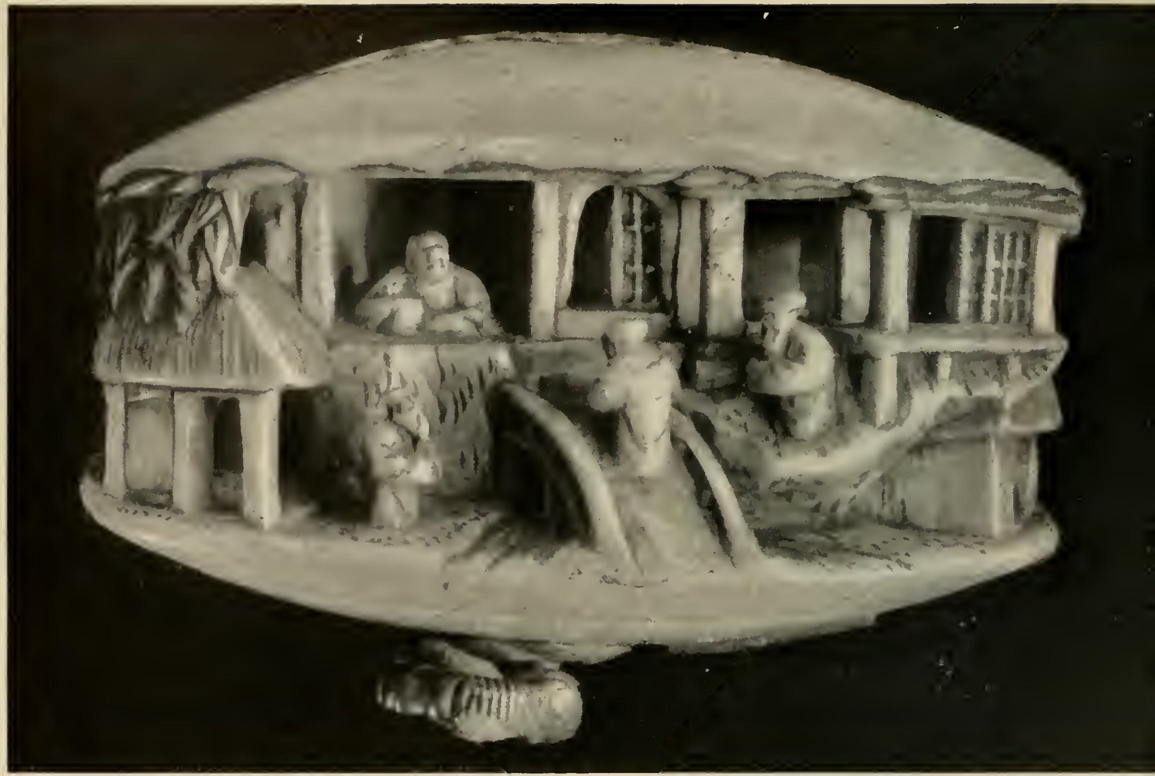
The odd little figure of Daruma is one very often met with among ivory netsuke. Daruma was a sage who, according to tradition, introduced the Zen sect of Buddhism into China. It is said that he remained seated, immovable, absorbed in meditation, for a period of nine years, at the end of which time his legs had "rotted away." He is usually represented in the act of stretching his arms at the conclusion of his long meditation, with his body enveloped in a garment like a bag



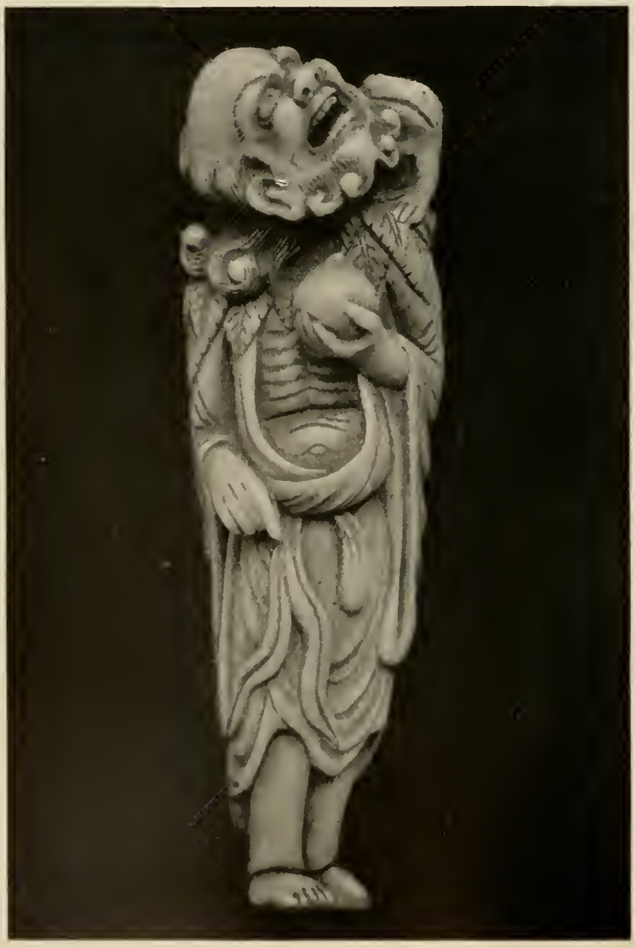
Among the many legends to be found in Japanese folklore is one relating to the "foreigners," strange races of people which like Othello's "men whose heads do grow beneath their shoulders" have some singular physical abnormality. By far the most famous of these and the ones most often represented in ivory and wood carvings are Ashinaga and Tanaga. Ashinaga has tremendously long legs and carries on his back Tanaga, whose enormously long arms reach down into the water. when Ashinaga wades out with him in order that they may gather the sea food upon which this coöperative pair lives



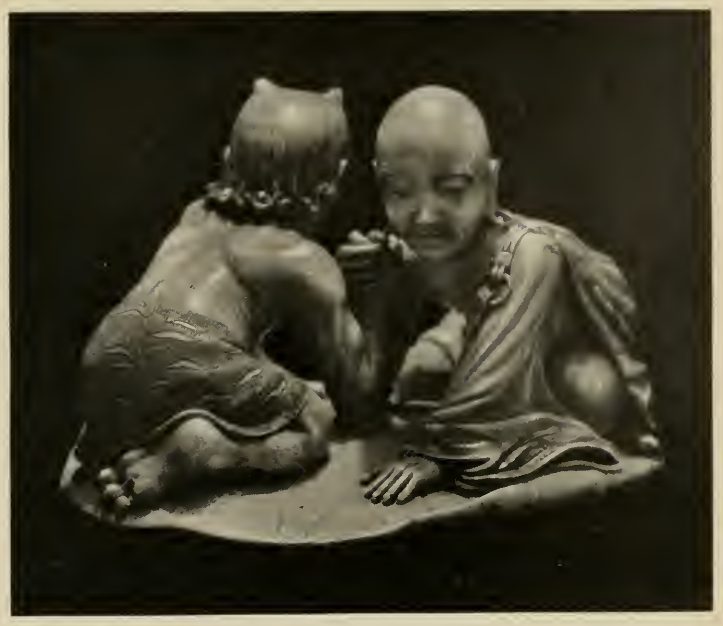
The fantastic figure above, executed in wood, represents one of the attendants of Riujin, The Dragon King of the Sea. He wears upon his head a sea dragon, and holds in his hands the fabulous jewel that controls the tides



The Palace of Riujin is shown in this ivory netsuke as being entirely included between the shells of a clam. Another conception makes it a sort of "cloud castle" that materializes from the "breath of a clam"

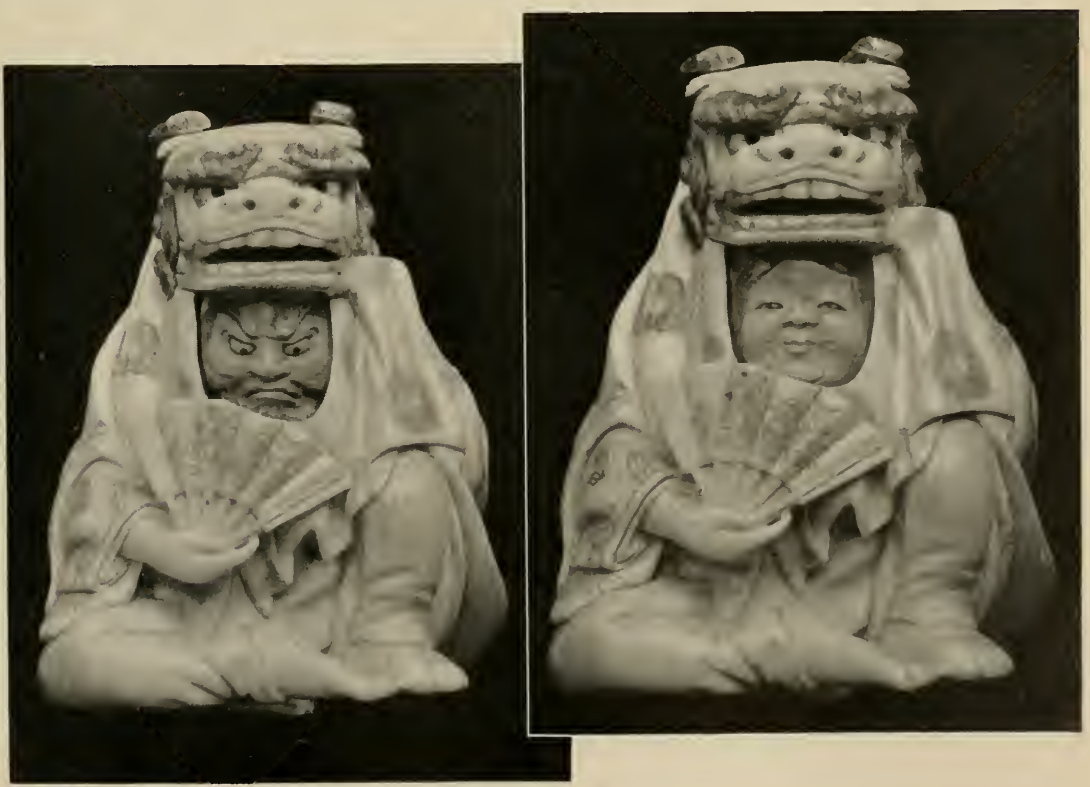


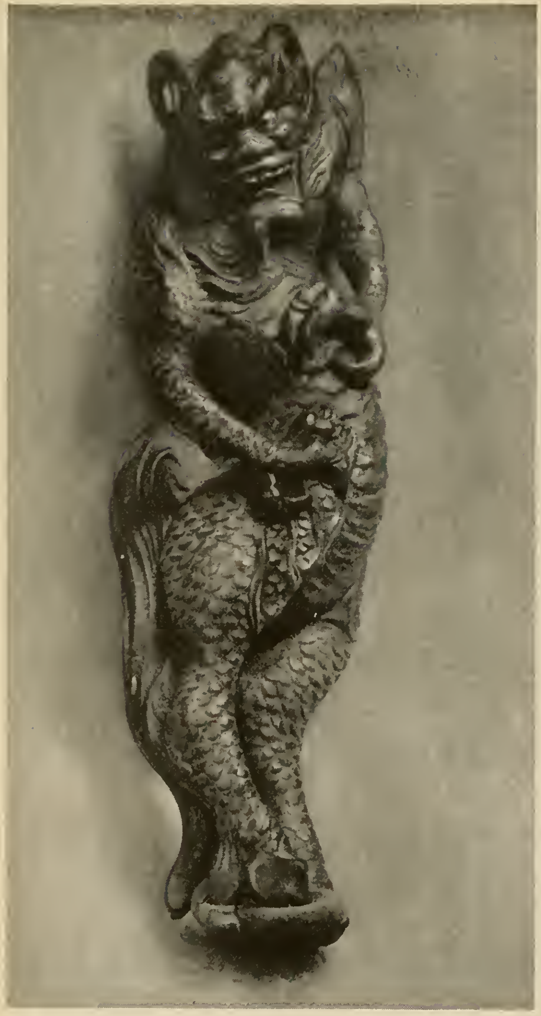
This ivory netsuke depicts the grotesque figure of Kosensei the Gama Sennin, or the Sage with the Toad. He is always represented with a toad crawling over his person. Sometimes this is represented as the mystic three-legged toad, but oftener it has its full complement of legs



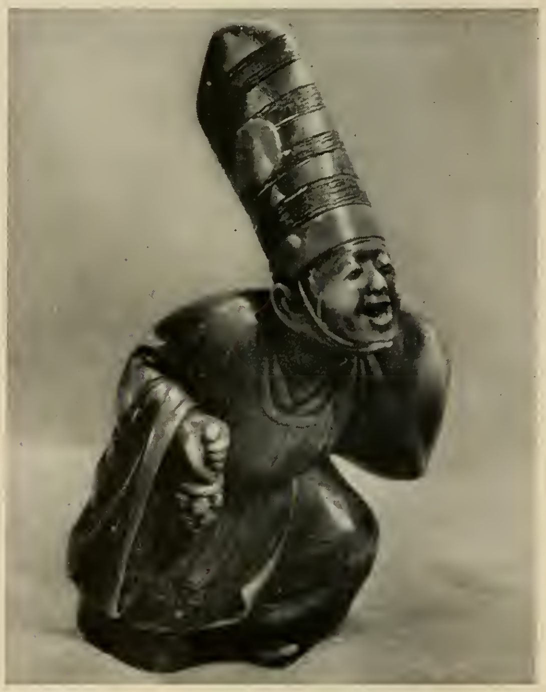
Upon the broad surface of this ivory lotus leaf a priest and an oni, the Japanese word for devil, are engaged in a match of udeoshi — arm wrestling. The identity of the oni is very apparent because, besides having rudimentary horns, he has only three fingers on each hand, and three toes on each foot. We are almost led to wonder if the priest really knows with whom he is contending

A Japanese street actor is called Shishimai, and plies his trade about New Year festival-time much as does a London "Punch-and-Judy-Show" man. The little ivory carving below is in reality a toy representing Shishimai, and is quite as capable of changing its mask as is the actor himself. A clever little wheel inside the figure revolves to a flick of the finger so as to show successively five entirely different masks. The illustrations show two of these

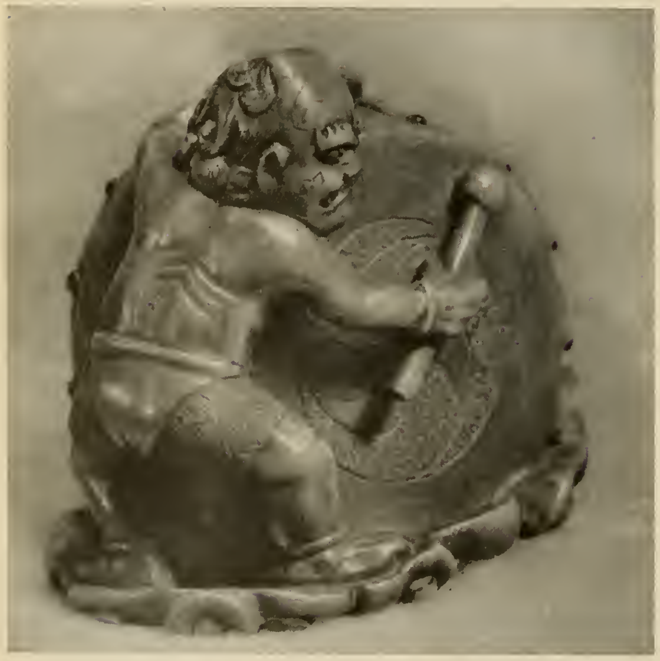




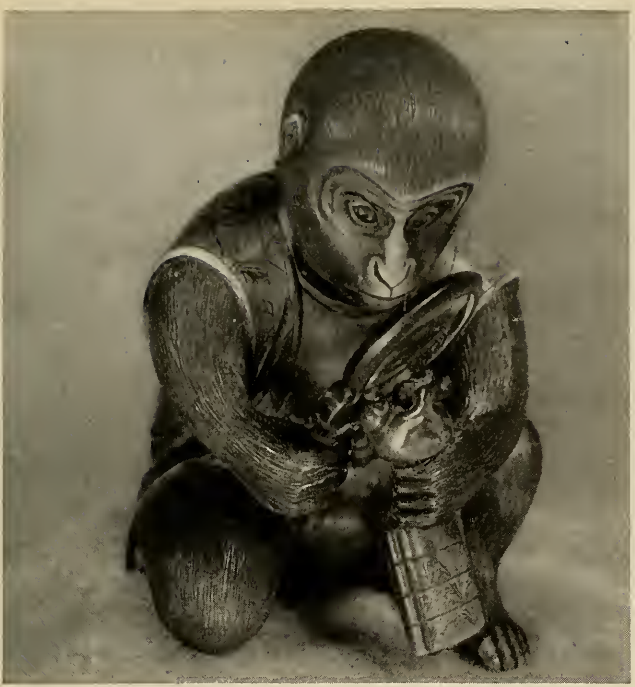
Like the Chinese, the Japanese are fond of depicting fabulous animals. One of the most richly variant of these is the Kirin, derived from the Chinese K'ilin or unicorn. The illustration at the left shows a standing Kirin executed in light-colored wood. This variety of unicorn has two horns instead of one, and seems to be covered with scales



Many of the dances, of which countless numbers are performed in Japan, are religious in character. The subject of the tiny netsuke above is performing Sambaso, the Earthquake Dance, said to have originated early in the Ninth Century to stop the disastrous effect of an earthquake. The mitre-like cap worn by the dancer is decorated with the red disk of the sun



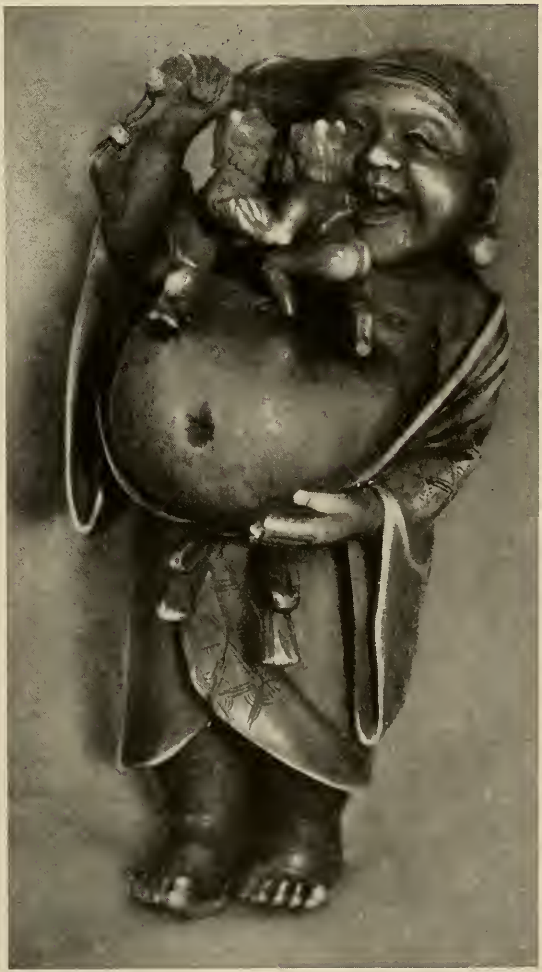
Raiden, the Thunder God, depicted in this little ivory netsuke, has a distinct demonic aspect. The face and rudimentary horns are those of an oni, as are the two claws that decorate each foot, and the three fingers on each hand. He is shown with the drum that he beats to produce thunder

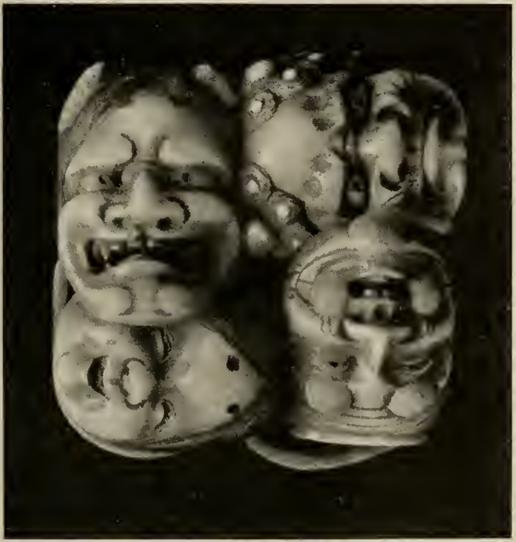


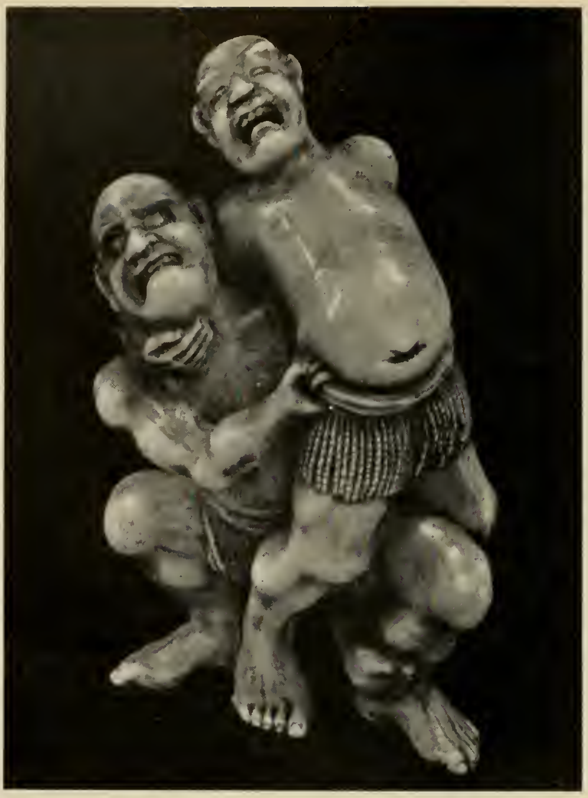
The monkey depicted in this highly humorous netsuke is looking through a magnifying glass at a netsuke carved to represent himself. One could almost imagine the monkey at which he is looking to be looking at a smaller monkey, and so on as far as one cares to carry the illusion

Hotei, the most popular of the seven "Gods of Luck" among Japanese netsuke carvers, is always represented, as in the example below, with a superabundance of flesh, and a very winning smile. Indeed, his generously extensive stomach furnishes a wrestling ground for the two little oni who are entertaining him. He may truly be described as carrying his Madison Square Garden with him

Masks are indispensable adjuncts to the Japanese Nō dances as well as to other theatrical performances. Consequently, they are very often depicted in ivory by the netsuke carvers, either singly or in such groupings as shown in the example below, which presents one or more grotesque faces on whatever side is turned to the observer

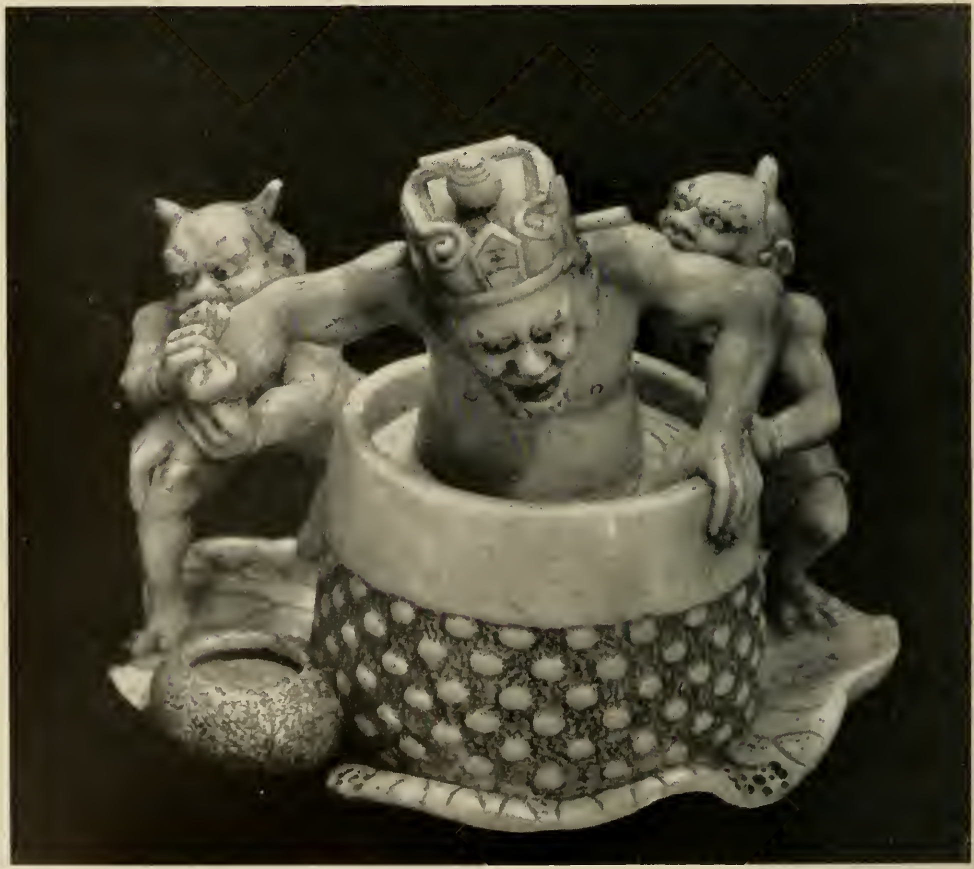


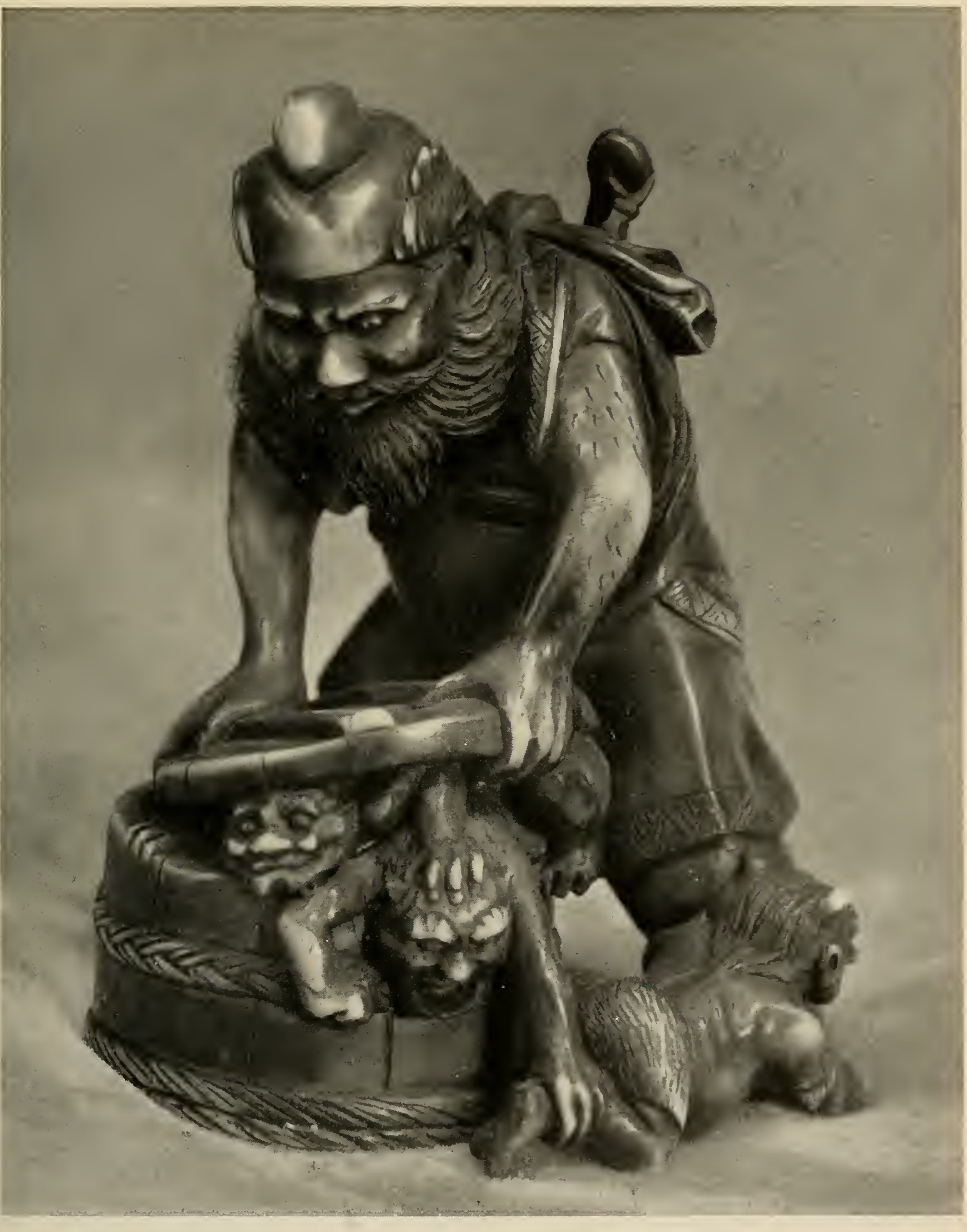




Wrestling is as popular in Japan as dancing. This ivory netsuke represents a throw invented by a celebrated wrestler who overcame his opponent when lifted by the loin cloth. This is known as Kawasu's throw

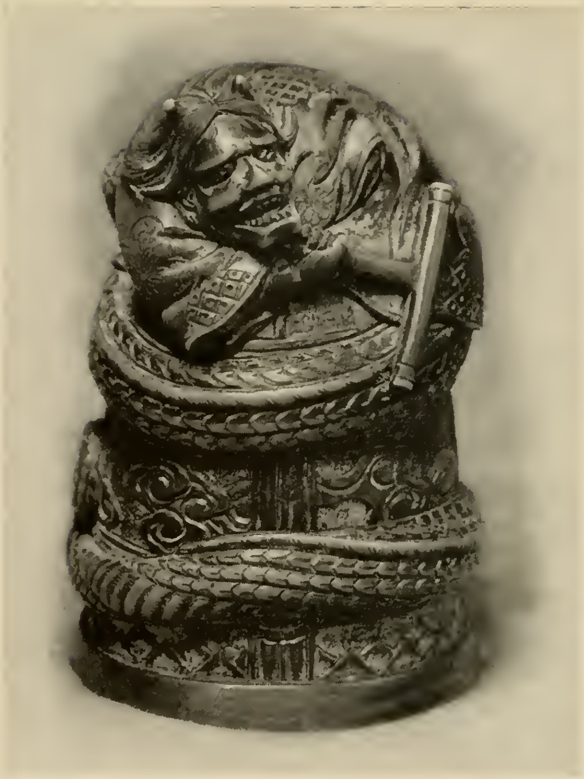
The subject of this beautifully carved ivory netsuke group is none other than Emma, the august Regent of Hell. He is represented as taking a bath while two attendant oni faithfully scrub him. It would be interesting to know whether the liquid is melted sulphur or boiling oil





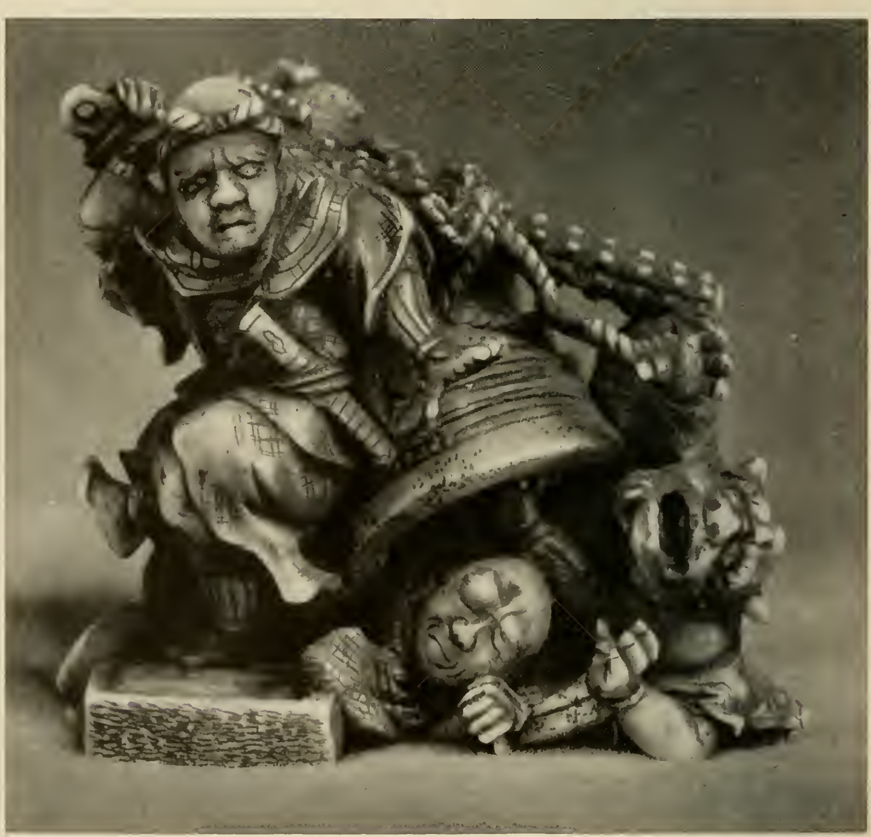
Shoki,
Queller
of Demons

Intimately associated with the demonology of Japanese myth is Shoki the Demon Queller. This mythical being. who has furnished the subject of many netsuke, was known in China as early as the Tang dynasty, and was the sworn foe of all the oni or devils. In this netsuke he is depicted as hunting down and capturing several oni in a covered tub



Kijohima, the heroine of this netsuke story, was the daughter of an innkeeper, who fell in love with a holy monk, named Anchin. Upon her advances being met with stern refusal, the love of Kijohima turned to passionate hate, and she summoned to her aid the infernal deities. She pursued Anchin into the temple, where he took refuge under the great bell, which was ten feet in height and enormously heavy. Kijohima, now consumed by a fury of baffled passion, began to undergo a change, her face became a witch's mask, her body became sinuous and dragon-like, and, as she wrapped herself around the great temple bell, flames, emitted from her person, melted it, effectually consuming the unfortunate object of her literally "burning passion"

The subject of this ivory netsuke is Benkei, a hero of the Twelfth Century, famous in Japanese legend. It is said that he was eight feet in height and had the strength of one hundred men. One of his celebrated feats of strength was the carrying away of the temple bell of Miidera. This incident is depicted with great wealth of detail in the carving shown below



because the pursuit of realism in art leads to the grotesque and the abnormal.

It may seem odd to us that the total absence of pockets in Japanese attire has so enriched an art, to say nothing of having produced a devoted band of netsuke collectors. Among these latter were the late Dr. I. Wyman Drummond and his father, James F. Drummond, and it is from Doctor Drummond's collection, now in the Drummond Memorial Hall of the American Museum, that the illustrations for this article are taken. In making a selection from the wealth of material contained in this famous collection, which includes more than 500 carefully selected netsuke, the writer has been at pains to choose those which have a story to tell rather than those whose high artistic worth transcends their mere interest. But, since the ivory artists of Japan never produce an unworthy work, choose as we may, these charming little carvings always appeal to our sense of beauty and fitness.

Even the grotesque ugliness of Tanaga or one of the attendants of Riugin has its enigmatic charm no less than has the captivating serenity of Wang Mu (pictured in "Jade, Amber, and Ivory," NATURAL HISTORY, September, 1934), or the infectious joviality of Hotei. We come to feel that these fabulous worthies have a reality akin to Peter Pan or Long John Silver, and as we all are well aware, that reality constitutes the acme of art.

A question that is often asked and that is somewhat hard to answer is "How old is the oldest ivory netsuke?" One does not hear of any antedating the Eighteenth Century; in fact, it is said that ivory netsuke carving began with the work of Yoshimura Shuzan of Osaka, who lived and worked early in that century. The Eighteenth Century ivory netsuke, however, supplanted similar work in wood, which latter dated from the Ashikaga period (1394–1573 A. D.).

All of the best ivory carvings of Japan are signed by the artists who made them. Tiny characters, usually filled in with red, appear in inconspicuous places on even the smallest carvings, and announce to the discerning eye of the expert that Masatoshi or Tomotane of Kyoto created the particular masterpiece.

Even in the matter of subject it is possible to recognize the work of a certain artist specializing in the portrayal of warriors, as contrasted with the work of one whose forte is the carving of demons or masks. And, as in all Japanese art, throughout this handicraft runs the touch of realism like the golden thread of Truth.

A story that the late Doctor Drummond delighted to tell (I have heard it many times from him), runs something like this:

A wealthy Japanese nobleman once said to a craftsman in bronze, who belonged to his entourage:

"I wish you to make for me a sword guard that shall depict a crane flying across the disk of the full moon."

"Very well, Master," replied the artist.

Many months elapsed before the nobleman again summoned the sword guard maker.

"And have you yet made for me the flying crane and the moon disk?" said he.

"Not yet, Master," was the reply.

Years passed and finally the noble patron said to his servant:

"Why have you not fulfilled my wish and executed in bronze a crane flying by moonlight?"

"Master," replied this supreme realist, "every moonlit night have I watched the face of the moon these many years, but never have I had the fortune to see a crane flying across its silvery disk."

And so well did his master sympathize with the high ideals of his art that the matter was dropped and the sword guard was never made.

Holland Defeats the Sea

For two thousand years the people of the Low Countries have fought the sea, and now are about to win the greatest of their struggles against it

By Harold Ward

Photographs supplied by courtesy of the Netherlands Railway

HOLLAND is an engineer's paradise. From the time when the ancient Batavians — of whose valor Julius Cæsar was well aware — lay claim to a sponge of earth trapped between three rivers and the North Sea, the Netherlands have been a battleground between man and the elements. Treacherous, yet of astounding fertility and charm; cradled upon waters which by turns threatened a nation and built an empire; inciting to courage by its very desolation; compelling unceasing vigilance from a people whose very lives depended upon a long, gray line of ramparts against an ocean whose child it is — the soil of Holland has yielded to man's needs only through man's intelligence, ingenuity, and resourcefulness.

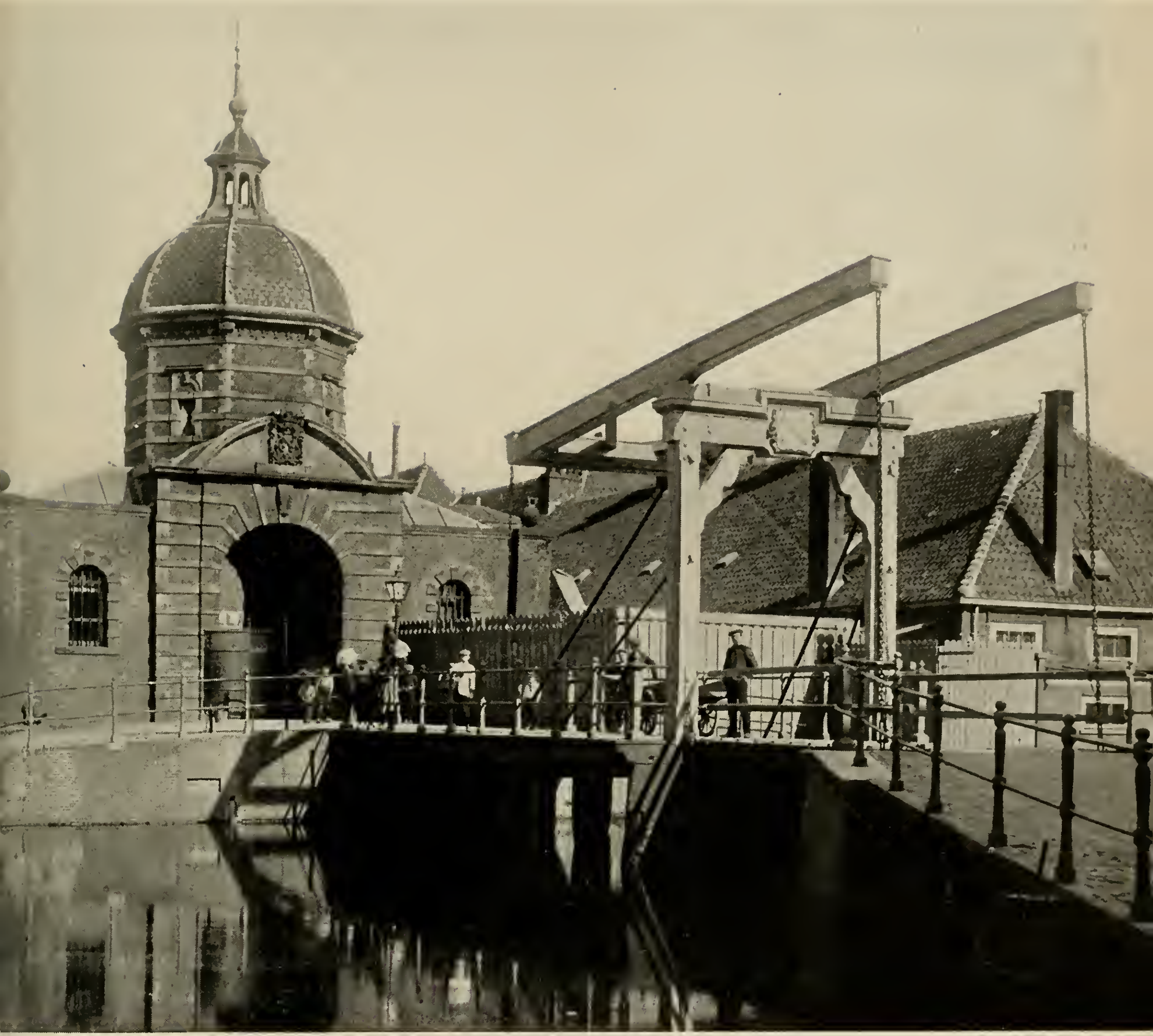
In this warfare of centuries North Holland has played the major rôle — though southward, in the island-network of Zeeland, the struggle has been sharp and bitter. North Holland, geologically among the youngest of lands, is peculiarly a product of the waters; there the Rhine, the Meuse, and the Scheldt, with their tributaries, have laid down the fertile sediment which seemed, to a gold-maddened Philip the Second of Spain, worth the butchery of hundreds of thousands. Great, sprawling lakes dotted the landscape: Beemster, Purmer, Schermer, and Haarlem. The first three of these were attacked and conquered during the Seventeenth Century — the Schermer last, in 1632. Not until two centuries had passed, was the demon, Haarlem Lake, vanquished, leaving behind more than two score thousand acres to be converted into crops by the indefatigable Dutch peasants. Up to the year 1600 the Netherlands had lost to the sea, by floods, storms, and tides, 1800 square miles of land — of which 1300 square miles had been reclaimed. With success the Dutch engineers grew more confident, more skillful — and turned their minds eagerly to the greatest problem of all — the one-time Flevo Lake, whose gradual expansions under the impact of floods and immense tidal currents finally established contact with the North Sea. Thus came into being the Zuider Zee — and with it the stupendous dream of its eventual reconquest, by and for the descendants of the "Sea-Beggars" who feared nothing in heaven or on the earth.

The reader may judge how they have realized this dream.

* * * * *

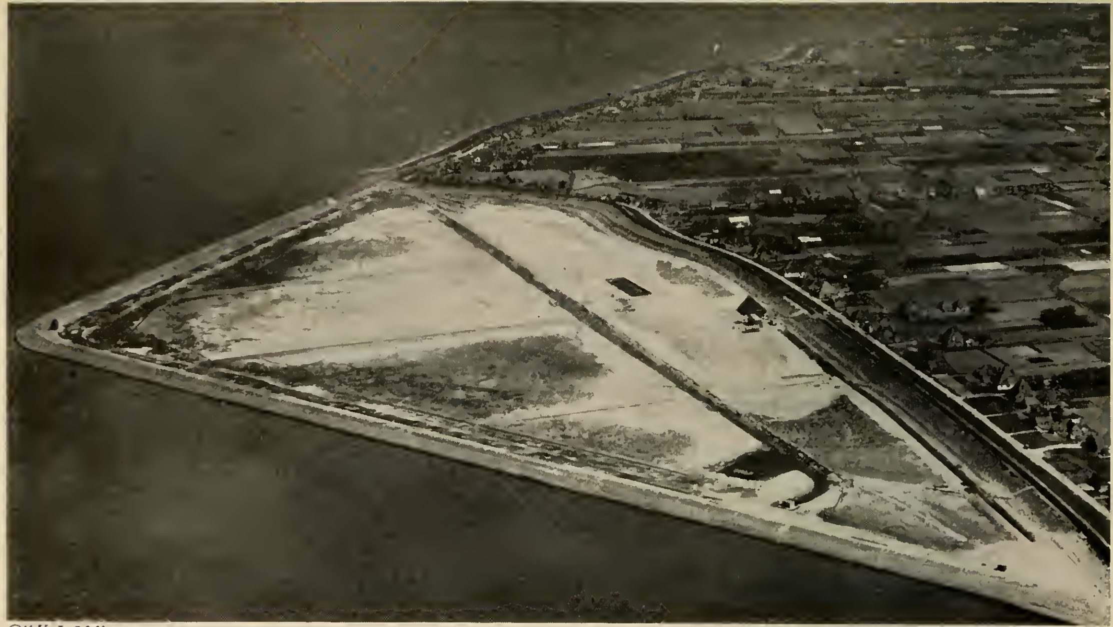
A few weeks ago there appeared a brief news item under the headline, "Refugees settling Zuider Zee land; German Jewish colony in the reclaimed area opened by the Netherlands." Ten days later there was another, but still tantalizingly short account, "Holland's Zuider Zee now supports colonists." Behind this casual print is a drama which has been going on for a thousand years, and is likely to continue for another thousand — the drama of Holland's struggle with the sea. Imagine a country of some 13,000 square miles, of which nearly one quarter is below sea level, and one tenth occupied by an arm of the North Sea which has made history and tragedy for the Dutch since the year 1295. Place on this area about the size of the state of Maine a population of more than 8,000,000 representing a density of over 600 per square mile (comparable to that of Japan, and fifteen times that of the whole United States); allow to this population five and one-half million acres of remarkably fertile land on which it must depend for the bulk of its food crops; give to it, of other land-

The Morspoort



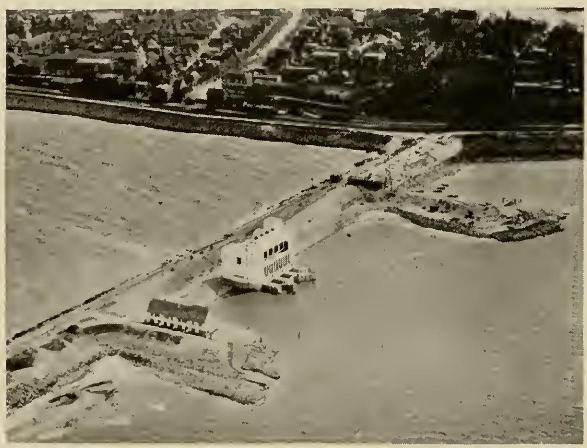
A Gate at Leyden

This particular gate, constructed toward the end of the Seventeenth Century, is one of the only two that now remain. In the center of the city there is a more interesting and far more ancient structure. On an artificial mound, erected in Roman or Saxon times, stands De Burcht, an ancient castle. The mound on which it was erected is representative of the earliest efforts of the inhabitants of the country to create dwelling places above the ever present menace of the waters



©"K.L.M."

A test polder at Andyk. This small field, one of the first steps in the reclamation of the Zuider Zee, was created in order to learn how cereals would behave on the salt-soaked soil



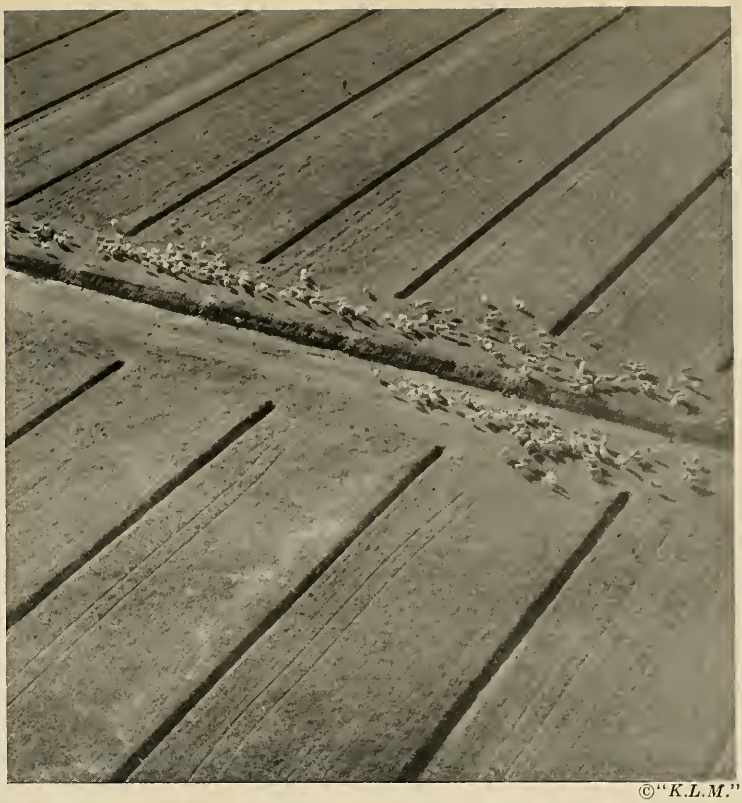
©"K.L.M."

The picture at the left and the one below illustrate certain of the engineering features of the dam, the sluices, and the pumping plants

©K. Maaskant, Wieringen

The engineers of Holland have long since reduced to a formula the method of draining land that lies below the level of the sea. The ditches shown in this picture are an essential part of the reclamation of such land

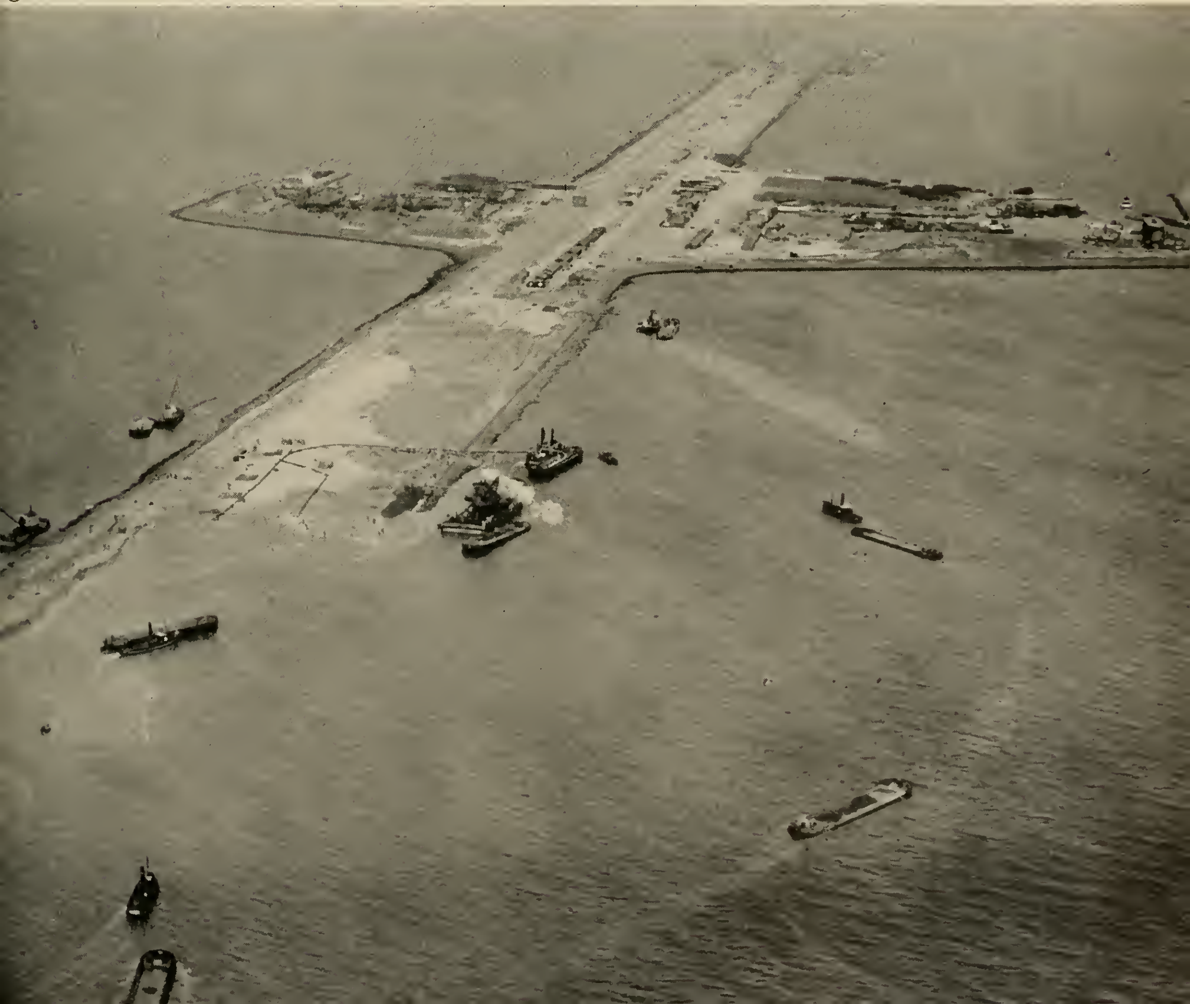
New Land in the Making



©"K.L.M."

(Below) The major feature in the preliminary work of reclaiming the Zuider Zee was the construction of the dam separating the area to be reclaimed from the North Sea

©"K.L.M."



consuming factors, 600,000 acres of forests, 4500 miles of canals, and 15,000 miles of roads, 300,000 horses, 485,000 sheep, 130,000 goats, 2,000,000 hogs, 25,000,000 chickens, and 2,360,000 cattle — and it becomes as clear as daylight why the Dutch Government decided, back in 1918, that the odd half-million acres of lush soil covered by the waters of the Zuider Zee must be restored to human uses.

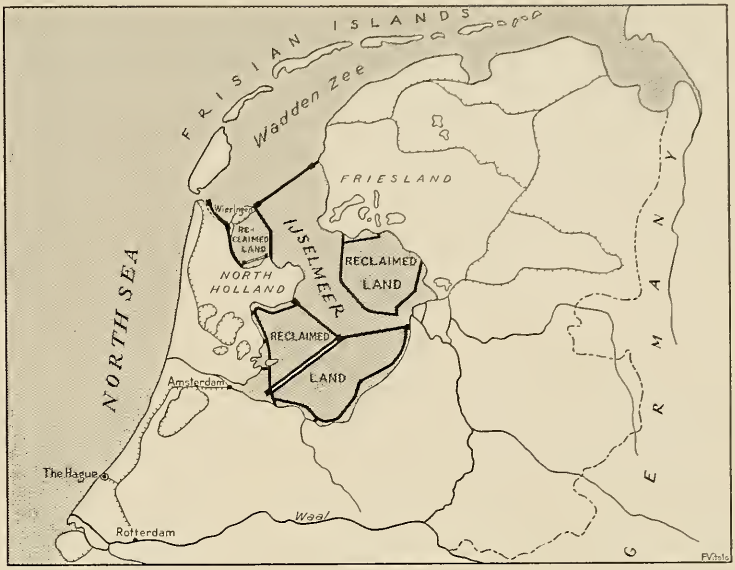
One acre of land for every inhabitant; of actual farm holdings 90 per cent are of less than 50 acres, and more than 50 per cent of less than 12 acres: not an encouraging picture for a country known since the time of Julius Cæsar for its pride and love of independence! Compared with the gigantic "collectives" of the Soviet Union, the vast spaces of Australia, the Argentine, and the United States, Holland (minus its colonial possessions) is not exactly a favored nation as regards its natural resources. Just for that reason, perhaps, the Dutch people have become a classic example in making the most of what they have. Is not the motto of the Lion of Zeeland *Luctor et emergo* — "I struggle and emerge"? And was not the Zuider Zee itself made to fight for the Seven Provinces when the Duke of Alva sought to make them, and the whole of Europe, safe for the Inquisition?

Beginnings of the Conquest

First steps in the conquest of this unruly Old Man of the Sea go back to 1877, when plans were discussed — and discarded. Ten years later the newly-formed Zuider Zee Union got to work in earnest: the chief of its technical committee, an engineer of genius named C. Lely, made the most elaborate investigations, as a result of which he drew up plans providing for the reclamation of four separate plots of ground or "polders" totalling 555,000 acres. Every detail, from the gigantic main dam stretching for nearly twenty miles across the open sea between Wieringen Island and the Frisian mainland, to the drying out of the reclaimed soil, was attended to so carefully that the Lely plans were adopted by the Dutch Government as the basis for the actual work. Not until 1918, however, was this work finally authorized, and further delays, due to the War, to the growing public debt, and to other internal difficulties, postponed regular operations until 1926. Six years later, in 1932, the North Sea was finally shut off from its landward arm by the greatest dike in the world, and the first "experimental polder" of 48,000 acres south of Wieringen Island (now actually part of the mainland) was put under cultivation. "Nieuwersluis" is the name given to the 175 acres being occupied by the German-Jewish colonists under a ten-year lease from the Dutch Government.

As laid down in the Lely blueprints, the Zuider Zee project provides for a central core in the form of a fresh-water lake, the Ysselmeer, of 560 square miles, to take care of the flow from the rivers Yssel, Rhine, Scheldt, and others. The four polders will adjoin this lake, from which they will be assured, through a most elaborate drainage and canal system, of unlimited supplies of *fresh* water. It is expected that the work itself will continue more or less steadily for the next twenty-five years — until 1958; each new plot of reclaimed ground coming into the market at a rate permitting the Government to dispose of it profitably. This question of a reasonable return on the investment assumes considerable importance when it is realized that the cost of the main dam alone came to $35,000,000, and that the total cost of the entire reclamation project (maintenance not included) will be more than half a billion dollars. Despite the colossal proportions of this undertaking, *direct* human labor upon it is not expected to be in excess of about 3000 men during the next ten years, the number decreasing thereafter. This is not a very marked "improvement" of the Dutch unemployment situation, with some 300,000 "officially" jobless people to be provided for.

There is, however, another side to the picture, showing that, if the Zuider Zee reclamation project is a gamble against nature and against complex economic forces, the probable gains are well worth it. The most important of these gains — or at least advantages — are worth summarizing, if only because each of them separately and all of them taken together give a vivid



How the Zuider Zee is being reclaimed. The portion of this map that includes the Ijselmeer (Ijsel Lake) and the several areas marked "reclaimed land" were formerly the Zuider Zee. The great reduction in its area is thus apparent at a glance. It may be noted that "Ijselmeer" is also spelled "Ysselmeer," and so appears in the accompanying text

idea of the gallant struggle going on between one very small country and a terrifying array of hostile elements.

Since 1846 — to begin with recent times only — a total of 250,000 acres of valuable crop and dairy land have been retrieved from the sea: a rate of 10,000 acres a year. Every one of these acres, despite the cost of dikes, drainage, and other maintenance charges, has paid for itself many times over. The most dramatic of these gains — that resulting from the impounding of the reckless Haarlem Lake at a cost of about $6,000,000 — added 42,000 fertile acres. So reclamation work not only can but *must* pay.

Second, the alluvial soil ("deposit-land" as it is known to geologists) of which the greater part of the Netherlands is composed is famous the world over for its productivity — as we know from Egypt, whose land is also a gift of the rivers. In wheat, for example, the yield per acre from Dutch soil is 46 bushels: almost three times the yield in the United States, and equalled only by Belgium, Denmark, and the Irish Free State. For rye the figure is 33.6 bushels per acre for Holland, as against 12 for the United States; and for oats 59.8 against 30.1 for this country. Add to this the further fact that the Zuider Zee lands, when finally dried out and "de-salted," will be loaded with the accumulated fertilizing chemicals of centuries of submergence, and you have another clinching argument for putting back the sea.

Third, the now completed main dam, plus the smaller one from the other extremity of Wieringen Island to North Holland and the supplementary "ring-dikes" to be constructed, will make possible the abolition of some two hundred miles of the old Zuider Zee dikes, thus saving an estimated $60,000 a year in maintenance costs, to say nothing of the added security.

Fourth, along the 112-foot top or "berm" of the main dam will be laid not only vehicular and pedestrian roads but a double-track railway. Besides lessening the distance and running time between Amsterdam and the North — a very great advantage — this will considerably relieve traffic congestion along roads which, with the canals, dikes, embankments, and buildings both commercial and residence, account for some 840,000 acres of precious Dutch soil. The fact that final closure of the Zuider Zee will permanently deprive Amsterdam of its direct outlet to the sea is neutralized by the existence of the famous Noord Zee Canal, whose terminus at Ymuiden today boasts the largest navigation locks in the world — not even excepting those of the Panama Canal.

One of Holland's many lovely orchards, similar, no doubt, to those through which Admiral Boisot and his indomitable "Sea Beggars" sailed their fleet when, under the leadership of William the Silent, the country was flooded during the siege of Leyden

Country

From this patch of land come some of the world's finest tulips and hyacinths. It lies near Haarlem, in the vicinity of famous Haarlem Lake, reclaimed about the middle of the Nineteenth Century

Rotterdam, with ready access to the sea, has benefited as a result of the comparative nautical isolation of Amsterdam brought about by reclamation projects

and City

A bridge crossing one of Leyden's many canals. This city stands in the midst of a large region that lies below sea level

Delft and one of its canals. This is, in reality, a carefully controlled stream, running from Leyden, past the Hague, and on to Rotterdam

Fifth, as mentioned above, the fresh-water supplies impounded in the newly created Ysselmeer will be of incalculable benefit for crop and livestock purposes, and also for industry. Losses directly traceable to absence of or deficiency in fresh water have been estimated at close to $2,000,000 a year. Huge locks in the main dike will give lake-access to vessels up to 2000 tons, thus permitting a considerable amount of water transport. The very elaborate drainage system to be used in connection with this lake, together with the dikes, sluices, locks, and subsidiary reservoirs, allows for a rise in level of nearly four feet. This height has been calculated on the assumption that the *worst* possible storms, floods, rains, tides *all occur at the same time* — a coincidence which has happened only once in the last seven hundred years. Worth noting in this connection is what the Dutch engineers call "overtopping," one of the most serious factors in a breakdown of the dikes. By this is meant the passage of high waves to the *land* side of the embankment, where they may effect much damage by scouring the earthworks and thus lessen resistance to pressure. It was in this way that Holland experienced one of the worst flood disasters in recent times, — the inundation of 1825, which submerged thousands of acres around the picturesque island of Marken below seven feet of water. Control of this factor is provided by the *slope* of the embankment on the water side.

Zuider Zee Fisheries

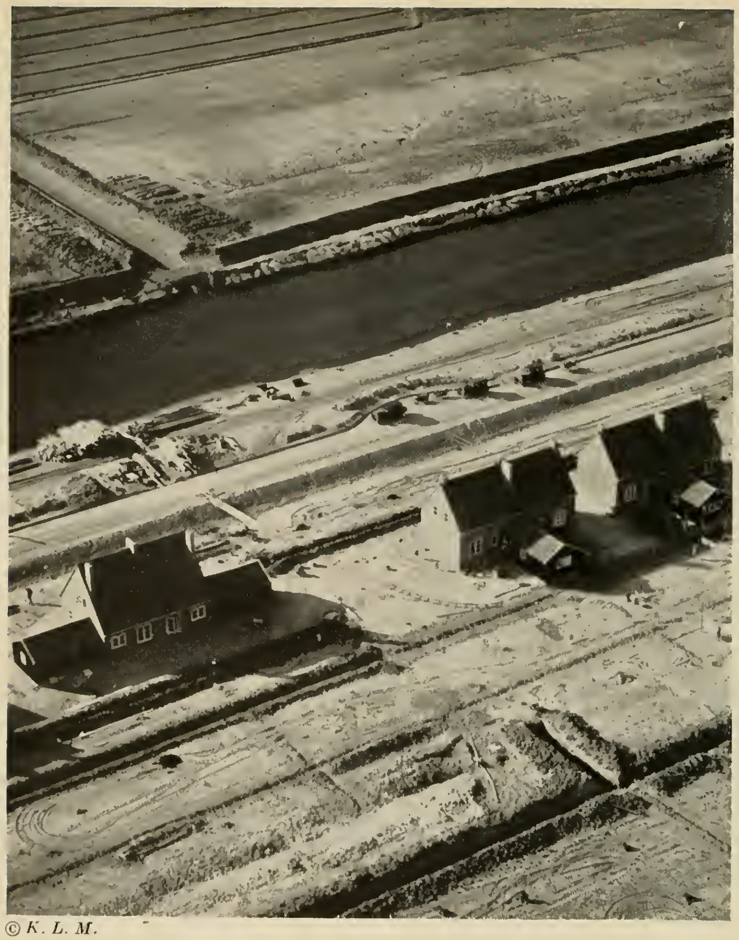
Sixth, the gradual liquidation of the centuries' old fisheries of the Zuider Zee: a problem which, because of the "human element" involved, looms much larger in the public mind than its economic significance warrants. Within recent years these fisheries have rarely supported more than about 15,000 people, of whom half actually did the work, with the help of some 3000 vessels. Taking the "catch" in the years 1910–1927 (herring, anchovies, smelt, flounder, and shrimps) at a yearly value of $1,500,000, we get an annual income *per fisherman* of slightly more than $200 — certainly not a generous return from a million acres of shallow salt water, shared among 15,000 dependents! Already, in order to supplement these meager earnings, the fisherfolk have been turning to the land and to dairying — for which more stable occupations the Government is providing considerable aid in the form of experiment stations, training schools, etc. Those who, because of age or temperament, are unable to give up the sea, will be settled on fishing grounds to be established off the coast of Wieringen Island — or they may have a try at the far less exciting work of exploiting the fresh-water fisheries it is planned to develop in the new Yssellake.

Seventh. Basic to the entire Zuider Zee reclamation project will be the 900 square miles of new arable land to be made available for a population which — contrary to general belief — is growing at a rate of about 100,000 a year. When, in about thirty years' time, these half million acres are actively producing food, dairy, and livestock products, it is confidently expected by the Government that a total of close to 300,000 people will be supported either on or by them. Theoretically, the average plot would be of about 85 acres, although in practice many of the holdings will be much smaller — and it must not be forgotten that the present land prices in Holland range around $400 per acre. The Government, however, has professed its willingness to advance 70 per cent of the occupation costs to those who acquire at least 50 acres of the new land, spreading the repayments over a period of twenty years. Revenue from the fully reclaimed land is estimated to be in the neighborhood of nearly $40,000,000 a year — an enormous increase over the sums realized from the fisheries which, with floods, storms, and costly technical maintenance, represented the principal "advantages" of the Zuider Zee. But whether, by 1958, the world economic situation will allow any government to earn anything under the still prevailing rules of the game is the question — the question on a favorable answer to which Premier Colijn and his government are willing to stake half a billion dollars of capital costs, and a very generous annual outlay for absolutely unavoidable maintenance costs.

Another less publicized but quite dra-

Conquered by Science

By means of thousands of these old windmills the original work of reclamation was carried to extraordinary lengths. Where, however, such power plants formerly pumped the always threatening water from the drainage ditches to the streams and canals that took it away, now they are almost entirely replaced by huge and ultra-modern pumping stations situated strategically all about the country



© K. L. M.

A view of a section of reclaimed land. In the great new "polders" reclaimed through the Zuider Zee project, scores of new communities are being created, in order to care for Holland's rapidly growing population

One of the beauty spots of the Hague. Oddly enough, though Holland's capital is situated on land that is well above sea level, it is not an ancient city. In the Thirteenth Century it was only a hunting lodge and did not receive the status of a town until early in the Nineteenth Century

matic advantage of this project must also be mentioned: that of national defense. Those who know their history need not be reminded of the rôle played in Dutch independence by the dikes whose deliberate destruction reduced all purely military assaults to a pathetic fiasco. And, at a very critical stage during the late War, when the Dutch government and people were gravely menaced by unlawful invasion of German troops, it was for a time merely a matter of lifting a telephone, and giving a few cryptic orders before huge sluices would rise, and the sea begin its dread work of submerging thousands of acres — and enemy machine guns. Today every detail of the Zuider Zee reclamation is being checked against the needs of similar defense: the Dutch "Waterstaat," one of the most powerful bodies of technical men in the world, has seen to it that the entire complicated system of dikes, canals, sluices, locks, reservoirs is integrated for the purposes of war as well as of peace. Special "flood-sluices" arranged at strategic points, with every facility for quick communication with the central government, are maintained in perfect condition at all times, and each of them operates with the precision of clockwork. What is particularly notable in this huge task is that the main pumping stations at Den Oever and Medemblik are so constructed that they can operate at full capacity even if the structures are submerged up to sixteen feet from the base — no small advantage in case an "act of God" (or of man) should bring about a temporary return to marine existence on an area whose soil is more precious than gold or rubies.

The engineering features of this colossal attempt to succeed where King Canute failed could be — and have been — the subject of volumes. A few words on the above mentioned Medemblik pumping station (at the southern terminus of the Wieringen polder) may fitly conclude this very brief account.

In a water-tight structure of reinforced concrete are housed three powerful centrifugal pumps, operated on a 3000-volt current "stepped down" from the 50,000 volts transmitted from Alkmaar, eighteen miles away. Working at full capacity, each pump can drain the land and subsoil of 80,000 gallons per minute: 4,800,000 gallons per hour, 115,200,000 gallons per 24-hour day — a grand daily total for all three pumps of 345,600,000 gallons, or more than one and one-half million *tons* of fresh water during one rotation of the earth around its axis! Needless to say, operation at such a rate is not expected to last beyond short periods of time. When the polders are fully reclaimed, it is estimated that the Medemblik pumps can perform their due share of work in a total of 1500 operating hours a year, at a power expenditure of 2,500,000 kilowatt hours. This work, all accomplished by electrically driven machinery tucked away in an inconspicuous building some fifteen feet below the level of the sea, will take care of an area of 36,000 acres, on which rainfall, percolation, and occasional overflows will deposit, in a year, moisture equivalent to 35 feet of water.

Two more pumps, in the "Leemans" station at Den Oever (at the western terminus of the main dam), have a combined capacity of 545 tons of water per minute, more than sufficient to help out in any emergency, besides caring for their own district. The enormous quantities of water handled by these — and the other pumps later to be installed — must be carefully transmitted through a system of discharge sluices, of which there are fifteen located at Den Oever and another ten at Kornwerderzand, near the Friesland coast.

All of this human skill, ingenuity, and ceaseless vigilance in order to allow each of the 8,000,000 inhabitants now teeming within Holland's 12,000 square miles of land surface additional elbow room at the rate of a little more than *six-hundredths of an acre* per person — not counting existing and prospective livestock, roads, buildings, and other physical essentials of an ordered society. Will this stupendous gamble of a valiant people against nature and against the ever-increasing pressure of economic forces within and without her borders succeed? There are realists who doubt it — but perhaps the realists have never fully understood that what *they* now accept as inevitable was once — impossible.

Five Hundred Fathoms Deep

The World's First Photograph of a Deep-Sea Fish at Home

By Otis Barton

> *"If Doctor Beebe and Otis Barton persist in their descents in the bathysphere, deep-sea fish may eventually have no more privacy than the traditional goldfish. Meanwhile, the fish figured in the following article has managed to conceal its identity in a cloud of light to such an extent that it is any expert's guess as to which of several known forms it may be. Nevertheless, by 1985 A.D., when entire life histories may be photographed in the abyssal depths, these first blotches of light on a black field may be treasured as the work of brave pioneers who opened up an environment that is as black as interstellar space."* — W. K. Gregory, *Curator-in-Chief, Living and Extinct Fishes, American Museum.*

STUNNED by the dazzling ray from the window of the bathysphere, it pauses, turns, and sinks slowly back into the blackness of the ocean abyss. It is a small bonita-shaped fish, possibly *Melamphaes.* Almost its entire side registers on the film as a sheet of flame. Only the fins and opercular openings are dark.

Thus, the world's first photograph of a deep-sea fish at home became an actuality. The picture was taken last summer, 3000 feet below the surface of the sea, through the fused quartz window of the bathysphere, which was operating off Nonesuch Island, Bermuda, under the direction of Dr. William Beebe and myself.

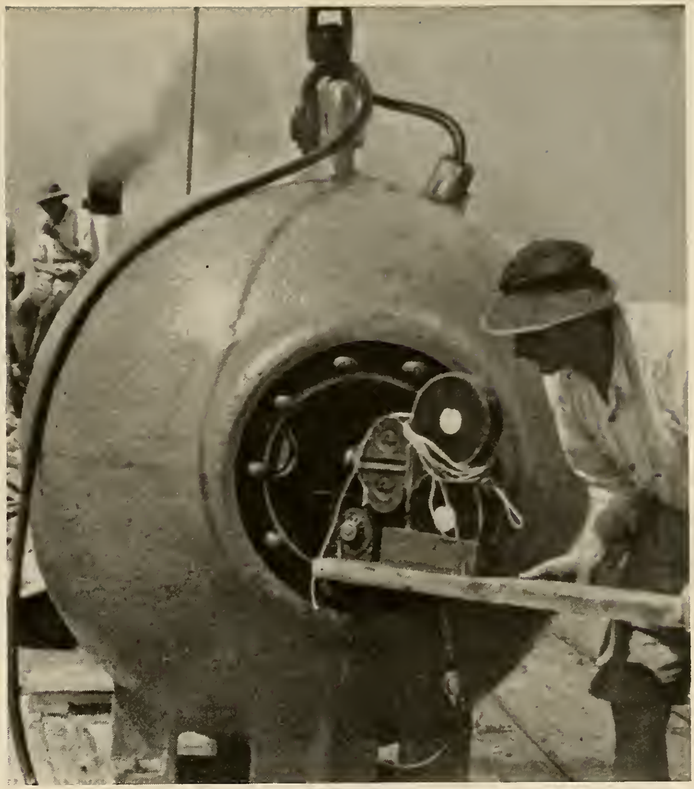
Also on this motion picture film are to be seen two fishlike forms that dip down for an instant into the shaft of light, and something that may be a baby squid or a larval eel passes horizontally along the lower border of the narrow ray. Outside the shaft of light nothing can be seen in this film. Neither with nor without artificial illumination have I been able to catch the phosphorescent lights of deep-sea fishes on any film, during three seasons' work in Bermuda.

Nor are these creatures 3000 feet down different from those I have often seen from the bathysphere with the aid of the powerful light. We can, of course, see many times farther than the distance at which it is possible to take photographs. I should judge that, when the light is on, we can see organisms at a distance of twenty-five feet at least, and by their own light alone, up to twelve feet at most.

Several times, when Doctor Beebe and I have descended in the bathysphere, I have attempted unsuccessfully to make a deep-sea motion picture, holding the camera myself. Doctor Beebe telephoned the deck crew more than 2000 feet above us to burn the spot light to nearly its full brilliancy. The beam from this 1500-watt lamp is the largest and brightest that can pierce through the six-inch fused quartz window into the water. When the bulb is burning close to its rated 120 volts, the heat radiating from it is very unpleasant, so great in fact, that we have often feared it might crack the window.

On the first day of our operation last summer, however, I had better luck. As usual, the bathysphere was to be lowered with no one in it on a safety test dive to 3000 feet. I attached our telephone wires to the motor of a large camera holding 400 feet of supersensitive film, and connected the wires of the spot light with a big generator on the deck. When the bathysphere reached the bottom of its test dive, the light was burned up to at least 140 volts, and the camera turned on electrically. Apparently the greater brightness of the light did the trick. This film is a little faint to be sure, but it is the first and only true deep-sea picture ever taken.

The camera enters the bathysphere. In the photograph at the right Mr. Barton is shown making ready the motion picture camera prior to the test dive during which, with no one in the bathysphere, the camera was operated electrically from the deck of the ship from which this deep-sea equipment was lowered



The first photograph ever taken of a fish in the deep sea. The white spot in the photograph below tells very little about the fish of which it is a portrait. Nevertheless, the fact that an unattended motion picture camera can be sent 3000 feet down into the blackness of the ocean depths, and can then be operated electrically, suggests a new and practical method of deep-sea exploration which, as it is perfected, may bring to light totally new and even unsuspected facts in the greatest unexplored region of the world

Microscopes for Amateurs

Fascinating fields of exploration await the person beyond the lens of the microscope, and even the amateur can now obtain inexpensive and effective equipment with which to experiment

By Julian D. Corrington

IT IS usually thought that the heights of drama in nature are reserved only for those few intrepid and wealthy souls who invade the African Blue or the Polar White. The rest of us have to stick on the job of earning a living, and must seek such adventures second-hand through the medium of sound films.

Or is it that we just think we must? The trouble is that most of us don't know where or how to look for fascinating experiences in nature.

If we take a long-time view of this world of ours, and concern ourselves with the drama of evolution, no more intriguing pastime for everyday study and enjoyment may be encountered anywhere than in the investigation of adaptations, most conveniently done with the microscope. Let us cast about and see.

Adaptations are those adjustments which organisms make in response to demands of their environment. Not consciously or immediately or individually, but through long periods of time and by great numbers of individuals. All successful organisms have long since become very well adapted to their particular environment, while such poorly adjusted plants as cycads, or animals as the rhinoceros, are surviving relics of much larger and more successful groups of a bygone day. Unable to change with a changing environment, the small, modern remnant is rapidly declining.

When we study adaptations, therefore, we are feeling the pulse of racial life, and the further we pursue this beckoning trail, the more interesting it becomes. To get the meat out of this form of investigation, however, we should follow it in detail; hence the suitability and allure of small forms of life. The deer and bear may be spectacular, but a flea, under the lens, may loom equally as large or formidable and moreover presents many concrete adaptations that are plainly evident and understandable.

Look over one of your canine or feline friends and relieve him of a few of his stowaways. Part the fur and search carefully in the neck region, where in most cases you'll observe some of these little brownies scurrying for cover. That they are not easy to capture will be quickly evident.

Put several fleas in a cage made from any convenient article of glassware, with a piece of cloth as a flooring. They will live for a considerable period without food and will provide splendid opportunity for observation of habits, especially as correlated with structures revealed by the microscope.

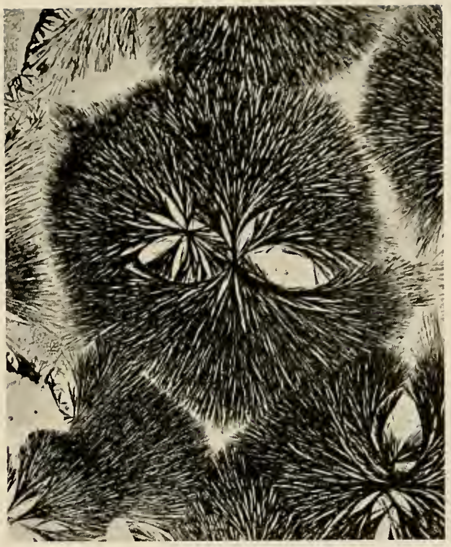
A number of other fleas should be dropped directly into 70 per cent alcohol, which kills them quickly and initiates preparation for mounting. After an hour transfer the insects to 95 per cent alcohol, and leave them for one hour or overnight, thence into aniline oil for a like period. The alcohol extracts all water from the tissues of animals and effects permanent preservation, while the aniline oil permits passage into balsam, the mounting medium, and also clears specimens, rendering them more translucent to the passage of light, which is important in obtaining a clear image.

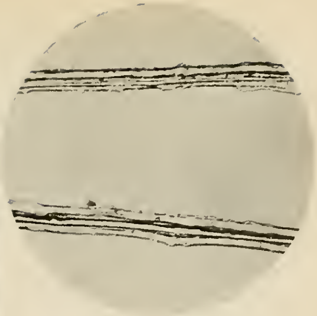
Now comes the mounting. A blank slide and a cover glass are thoroughly cleaned by dipping in alcohol, then wiping dry and polishing with a soft cloth. Cleaned glassware should be handled by the edges only. Blot the specimen for an instant on the cloth, to remove excess oil, then place on the center of the slide, with the insect's back surface down and legs up.

Straighten the legs so that they do not

Microscopic studies of certain crystalline forms bring out new and often unsuspected beauties in Nature. The rectangle at the right portrays a greatly enlarged view of caffeine crystals as they appear through the microscope

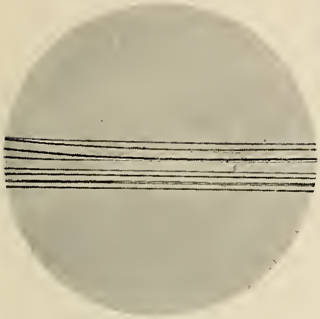
Ward's Nat. Science Establishment





Bausch & Lomb

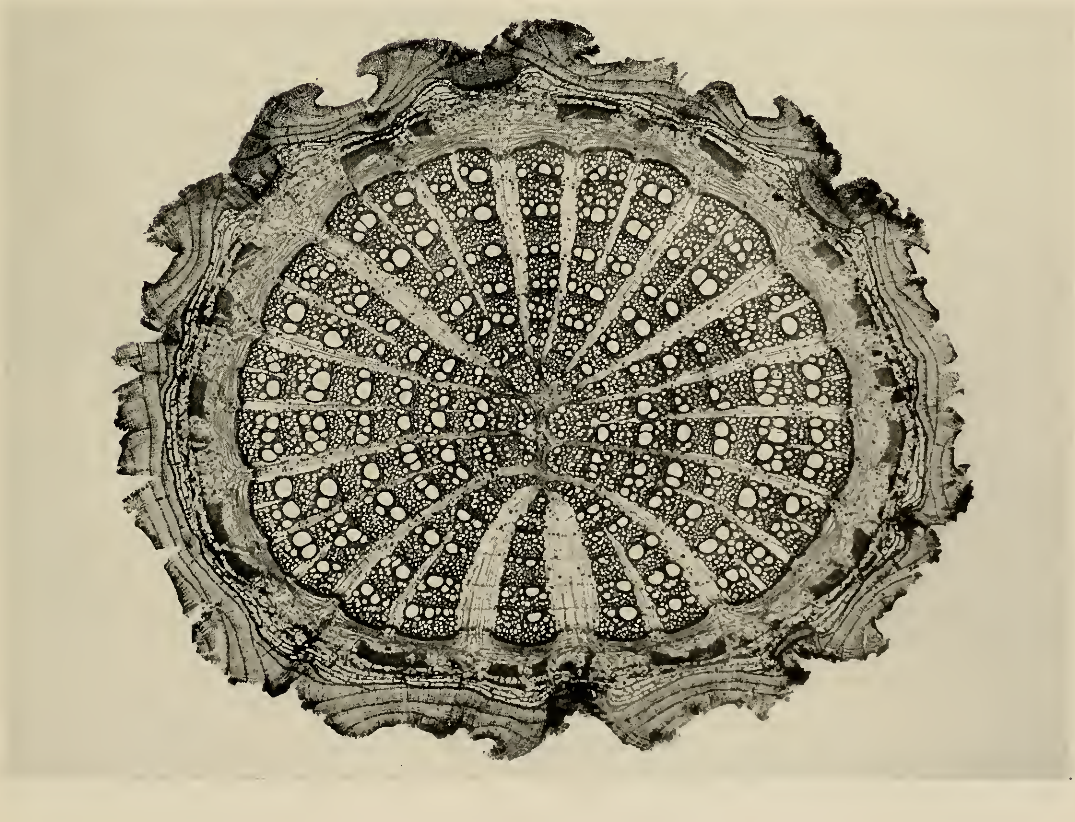
Many of the commonest materials offer fascinating opportunities for study to the amateur microscopist. In the circle above are shown two strands of real silk fibers, while the circle on the opposite side of the page shows comparable strands of rayon, or artificial silk



Bausch & Lomb

Photographed through a microscope and projected on to a screen, the greatly enlarged and splendidly detailed picture below shows a cross section of the stem of "dutchman's-pipe" (Aristolochia). *The original picture was even more striking because of the brilliant coloring of red and green stains*

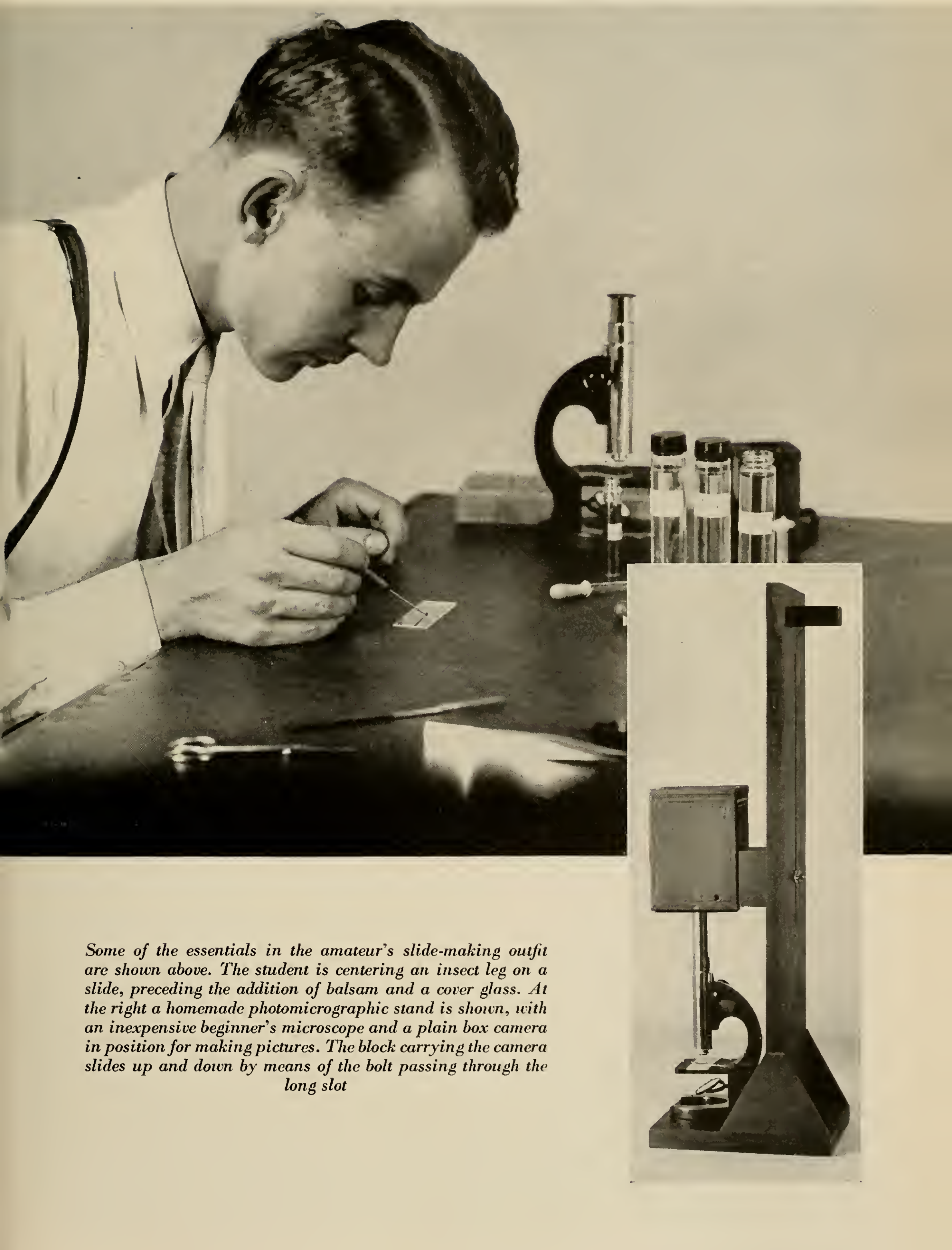
Bausch & Lomb



Making an exposure with one of the latest types of beginner's photomicrographic outfits. The camera is small and simple, and is equipped with a separate view finder

Projecting the image of a microscope slide on a screen with one of the simpler and less expensive of the micro-projectors. Such equipment is not essential to the amateur microscopist, but is capable of adding immensely to the enjoyment and understanding of the subject

Amateur Equipment



Some of the essentials in the amateur's slide-making outfit are shown above. The student is centering an insect leg on a slide, preceding the addition of balsam and a cover glass. At the right a homemade photomicrographic stand is shown, with an inexpensive beginner's microscope and a plain box camera in position for making pictures. The block carrying the camera slides up and down by means of the bolt passing through the long slot overlap and are more or less symmetrical, using needles mounted in wooden handles for this manipulation. Add two drops of balsam and let the cover glass fall gently into place upon the specimen, whereupon the balsam should spread out under the cover and completely fill up the space between cover and slide, with no excess to mar the tidiness of the preparation. The exact amount of balsam to use in any particular case has to be learned through trial. If you've never turned your hand to this sort of work before, you'll find slide making lots of fun.

Studying the Slide

After a slide is finished it must be kept level and used with care so as not to disturb or touch the cover. A better practice is to let it dry thoroughly first by putting it away in a flat position in some place free from dust, for a week or ten days. Or make a slide dryer by inserting an electric bulb in a metal box, the slides being placed flat on the top, where they will dry in two or three days. Clean and label each preparation when dry.

In studying the flea slide, note first the general adaptations of this highly specialized insect for the environment in which he lives. Imagine yourself in the flea's home, dwelling in a very dense forest of tall, slender trees, through which little light ever filters. At times giant spikes come plunging down in a glare of light through the roof of this warm, dank jungle, intent on your immediate annihilation, and at frequent intervals there appear huge forceps which attempt to impale you. That's the way the dog's claws and teeth doubtless seem to the flea.

Being well fitted to cope with these dangers, the flea has a hard shell which is smooth, shiny, and slippery, and a body that is compressed and oval in outline, very difficult for a dog's teeth to close upon, the flea often slipping from between them just as you can spurt a watermelon seed from between your fingers.

Unlike most insects, fleas have no wings, for of what use would wings be in such an environment? To compensate, however, the legs are especially well suited to creep swiftly about on the surface of the victim's hide, to cling to hairs with sharp claws, and finally to make prodigious leaps with the third pair, after the fashion of the grasshopper, frog, or kangaroo. By means of this jumping habit, the newly transformed adult flea gains its first host, and others may pass from sickly or dead animals to more auspicious banquets.

Observe the eyes and antennæ on the head of the flea; the eyes are greatly reduced and do not consist of the usual large number of compound facets customary in insects, while the antennæ are mere vestiges lying in grooves behind the eyes, instead of being the prominent, forwardly-directed, and highly sensitive feelers generally present in free-living insects. Sense organs lose much of their utility in a habitat such as that of the flea.

The mouth parts are formed for piercing and sucking, and may be seen on favorable mounts as a pair of tiny feelers plus one or more stabbing blades, the cause of certain qualifications going to make up a dog's life. Then there are combs on the sides and rear of the flea's head, very prominent features and serving to prevent backslip during forward progression, as well as helping to anchor the head firmly in place while the flea takes his nip of dog.

Quite an array of adaptive structures in these pestiferous little fellows. Interesting animals, fleas.

Inexpensive Outfits

If you make a good slide you can buy an inexpensive outfit to project the magnified image on a screen as part of an evening's entertainment for friends at home. The same apparatus may also be employed to throw an enlarged picture on a sheet of paper on the table, so that the insect is quickly and easily drawn by merely tracing the projection.

Then, if you are a camera enthusiast, the next step will be to take up a still more fascinating game, — photomicrography. Any type of camera may be hooked up with any model or make of microscope, and with but little practice very excellent photomicrographs can be turned out by even the rankest of beginners. Hunting with a

Bausch & Lomb

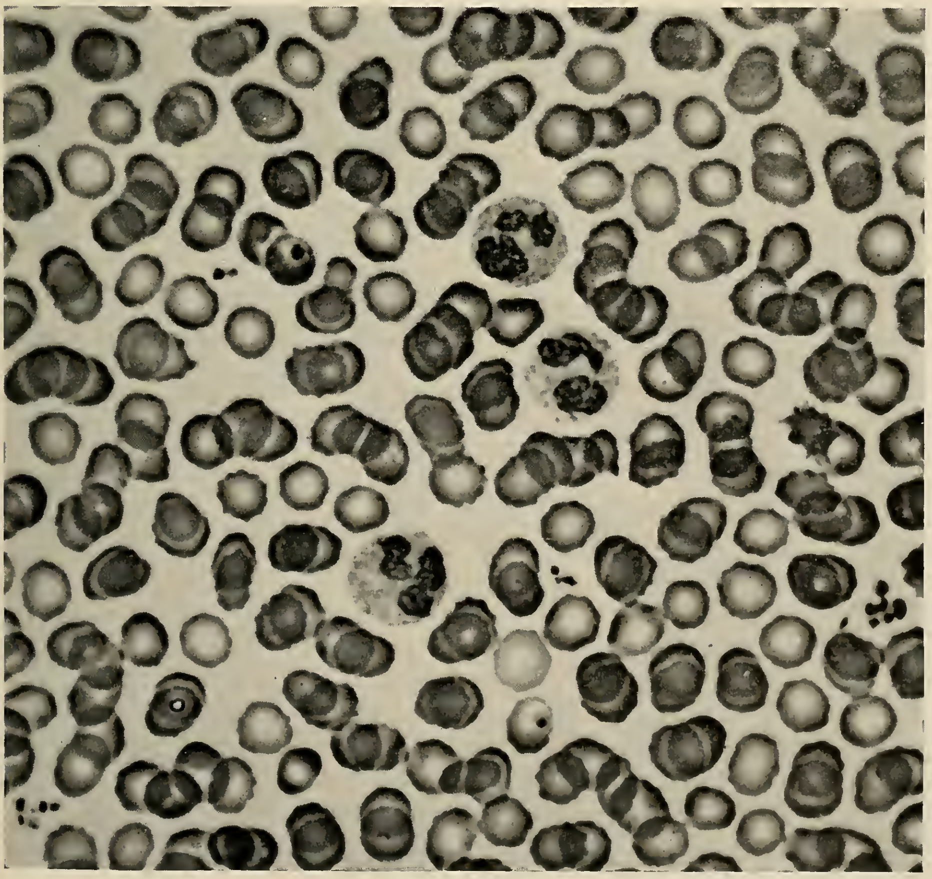
Under the microscope even a strand of hair, such as is shown at the right, reveals the complexity of its structure

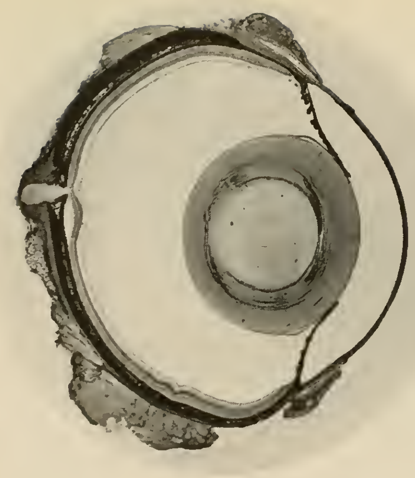
Below, an enlarged view of a portion of a human finger print reveals the intricate details upon which identification can so definitely be based

Bausch & Lomb

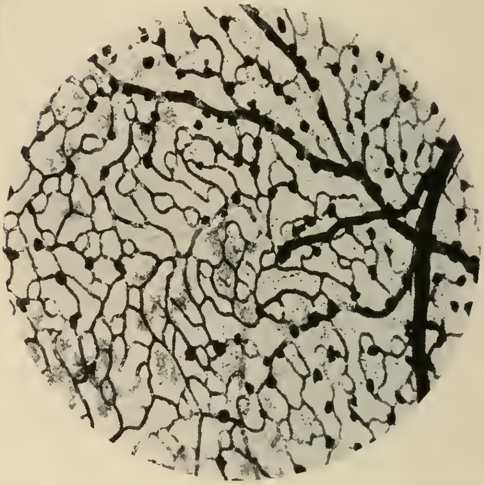
Human blood, as it appears under the lens of a microscope, is pictured below. Most of the cells shown are red corpuscles, many of them clumped together. The three larger round cells, with prominent nuclei, which appear in the center of the illustration, are white corpuscles. Tiny groups of dots showing in several places are the blood platelets

Bausch & Lomb

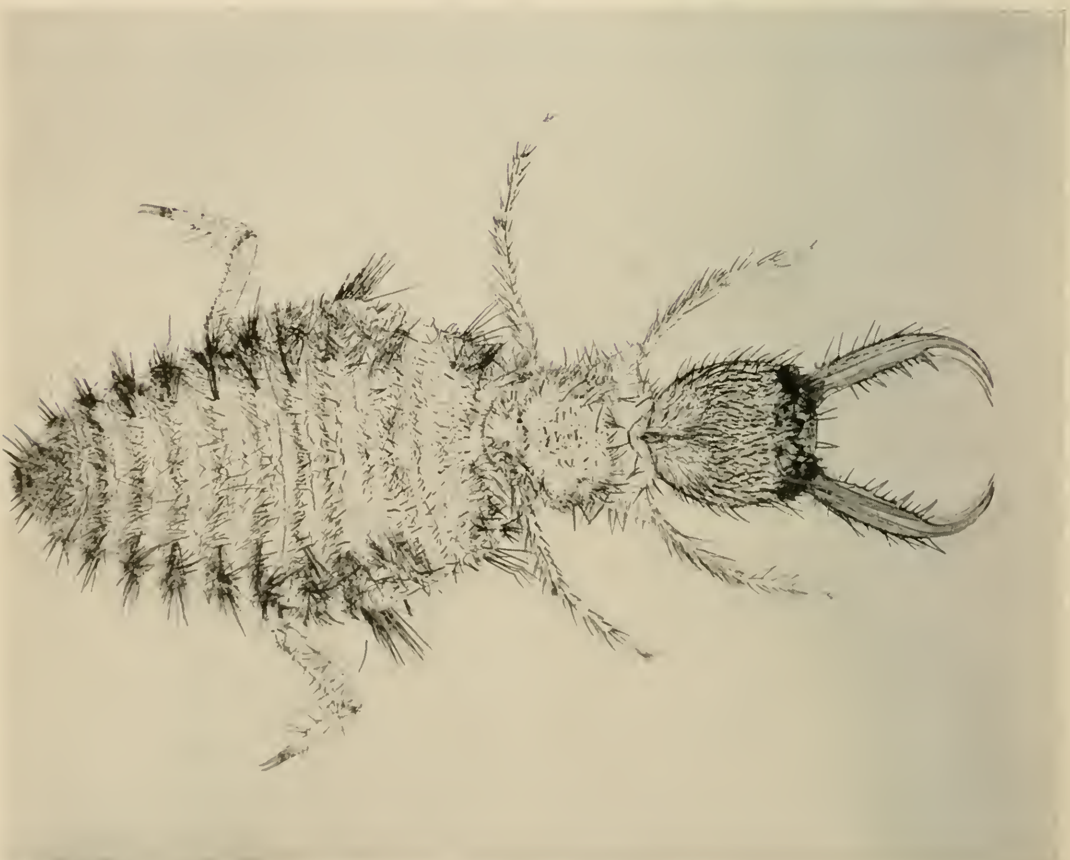




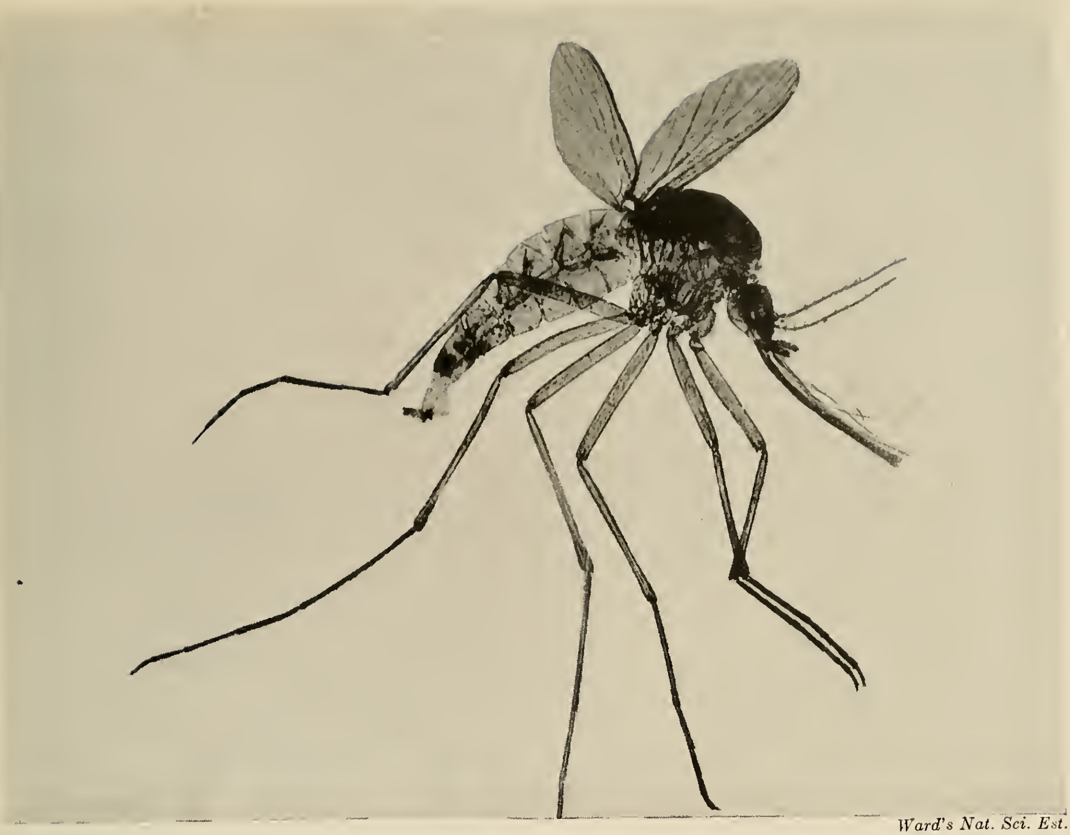
The circle at the left shows a median section of a frog's eye. From right to left the cornea, anterior chamber, iris and pupil, lens, posterior chamber, retina, and outer coats are clearly shown. Below is a photomicrograph of the web of a frog's foot, showing the capillary blood vessels



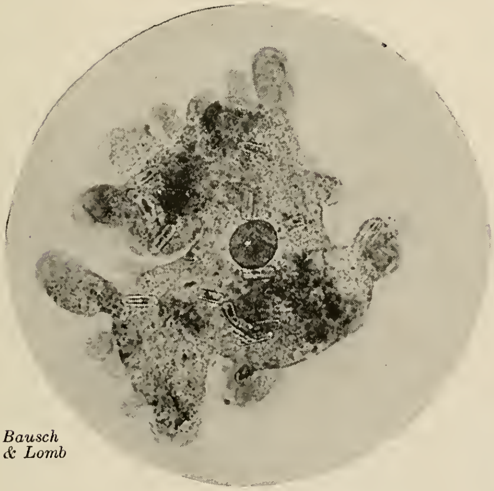
Below is a photomicrograph of a "doodle bug," the larva of the ant lion. It digs pitfalls in the sand and seizes ants and other insects that blunder into the trap. Under the microscope its "huge" jaws are shown in fascinating detail. In real life this tiny dragon is, perhaps, half an inch in length



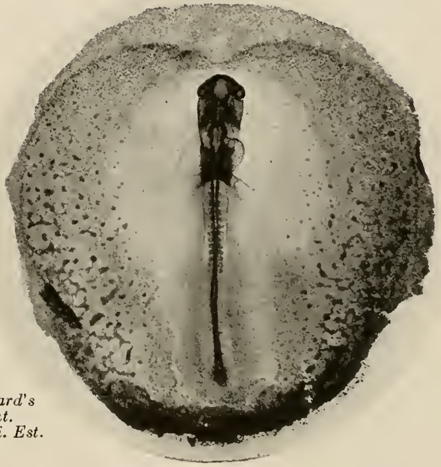
Photos from Ward's Nat. Sci. Est.


Ward's Nat. Sci. Est.

Mosquitoes can be studied to excellent advantage under the microscope. The specimen above is a yellow fever mosquito, the carrier of one of the world's most dreaded diseases. The insect is well arranged on the slide, with the result that wings, legs, and mouthparts can readily be observed


Bausch & Lomb

Amœba proteus, one of the most fascinating of protozoans, is shown above. The nucleus shows plainly, as well as a number of diatoms (unicellular plants) which the amœba has ingested as food. At the right the development of a chicken's egg is shown, thirty-three hours after the fertilization of the egg


Ward's Nat. Sci. Est.

camera has long been considered decidedly superior to the use of the gun, both as a sport and for the skill required. When the microscope is added, the thrills are multiplied.

A stand to support the two instruments may be purchased or homemade, as shown in accompanying illustrations. Use a strong light source, a shield of black cardboard around the microscope eyepiece to block off outside light, and a ground-glass focusing plate in the back of the camera. The diaphragm should be wide open, the shutter set at time exposure, and focus at one hundred feet or infinity. Make a number of trial exposures at ½ minute intervals each, from ½ to 2 minutes, determine which one was best for the particular subject and conditions, then gradually acquire knowledge by further trial shots. Experiment with colored filters, using a green one for your first pictures. Place a piece of green cellophane between two glass plates, such as lantern slide blanks, and bind with gummed tape. Stand this filter between the light and the mirror of the microscope.

Lilliputian Warfare

In a drop of pond water from a stagnant ditch or lily-pad pool, many a marvelous drama of the microcosm may be seen enacted if you, like an imaginary man from Mars, look down upon this scene as from another world. Amœba, that microscopically huge blob of protoplasm, will steal upon the unwary brother protozoan and embrace him with long, finger-like extensions which we term pseudopodia, or false feet, but which to the victim spell death. These pseudopodia form a cup which flows around and over the hapless organism, engulfing him in a viscous prison, where he may dash about futilely for a moment or so until overcome by digestive ferments which Amœba soon pours into this lethal chamber.

Now comes another giant of this bustling world, Paramecium, the slipper animalcule, hurtling along at prodigious speed, propelled by hundreds of tiny, lashing whips, the cilia. Encountering a particle of decaying vegetation, these cilia quickly reverse their motion, and Paramecium comes to an instant stop in order to sweep large numbers of bacteria down into its insatiable maw.

Even expert microscopists never tire of the constantly changing panorama of this world of the infinitely little. There is always something new to see and to learn. If you would invade these fascinating precincts, collect some material from any standing body of water, preferably one supporting an abundance of plant growth. Amœba prefers lily pads, but you will be certain to secure an abundance and variety of microscopic life if you fill a bottle with ditch or pond water and then stuff in some débris to make up about one fourth of the whole volume. Include some of the decaying leaves and mud from the pond bottom and a bit of the green plants or scums growing from the bottom or floating on the surface.

Under a cover glass mount one large drop of this culture, always including a little of the débris, and examine with low power, cutting down the light. For structural observations, after studying the activities of the living plants and animals, place a drop of iodine at the exact edge where cover glass meets slide. It will run under by capillary attraction and will kill all organisms present, at the same time staining nuclei and other features not evident in the living state. Owing to the incessant motion, photography should be attempted only after gelatin has been added to the mount to render the creatures immobile.

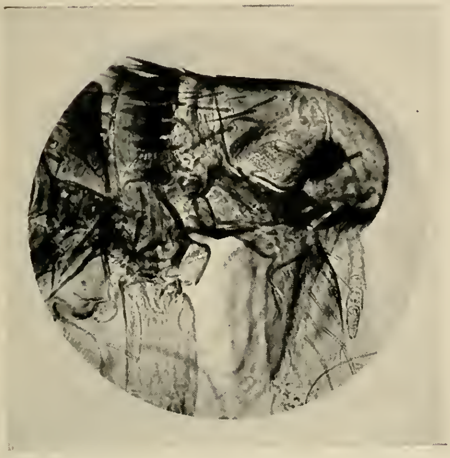
Slow-motion Elevators

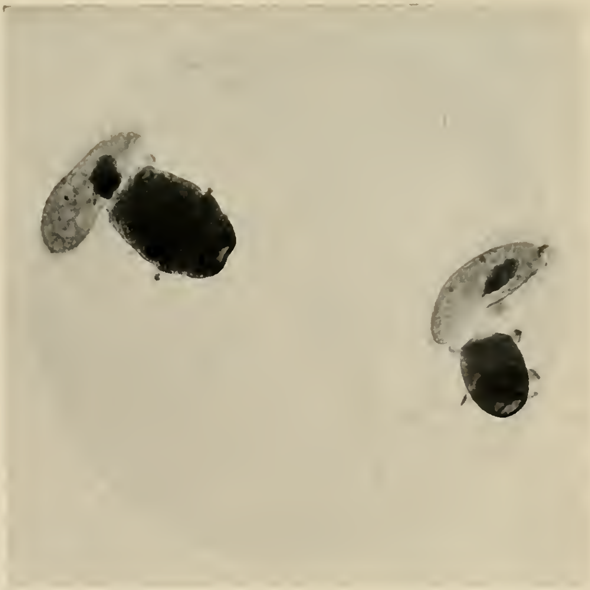
Perhaps your particular leaning is toward botany. If so, the microscope is an indispensable tool in your studies; for example, in the examination of plant stems, those important pathways for the materials which the plant uses in its metabolism. Cut off a one- or two-inch portion of the green stem of a young shoot, and practice making as thin sections as possible with a safety razor blade held in a carrier. The Razornife is such a tool, obtainable in many stores.

Cut cross (transverse) sections, keeping both stem and blade wet with water, and allow the slices to fall into a watch glass of

Bausch & Lomb

Below is pictured the head of a dog flea. Careful examination of this photomicrograph will bring out the comb, the vestigial eye, and the highly complicated mouthparts. The microscopic study of insects reveals many details that could hardly be imagined without the aid of the lens

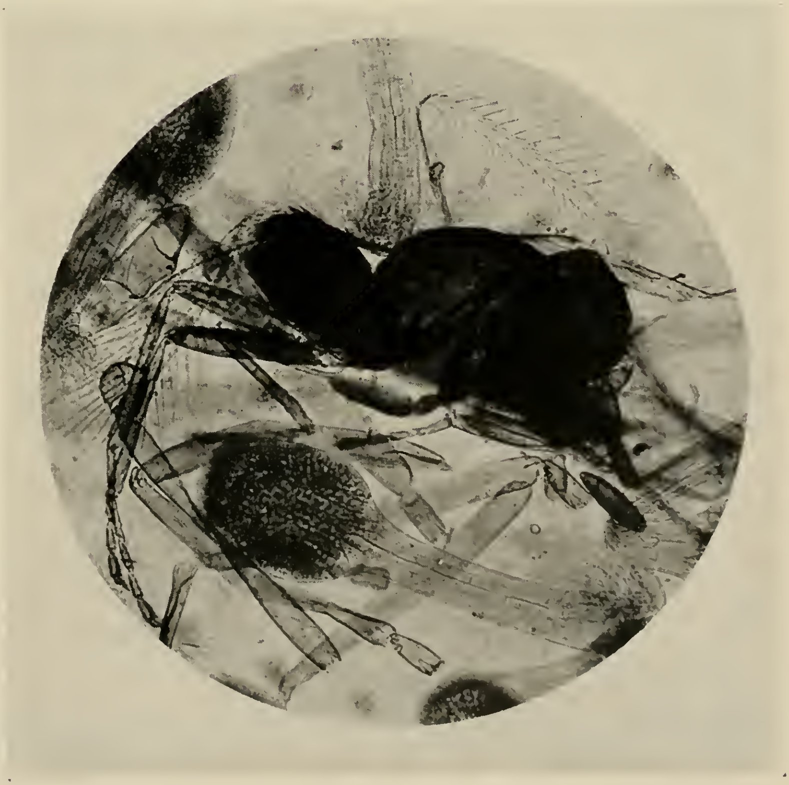


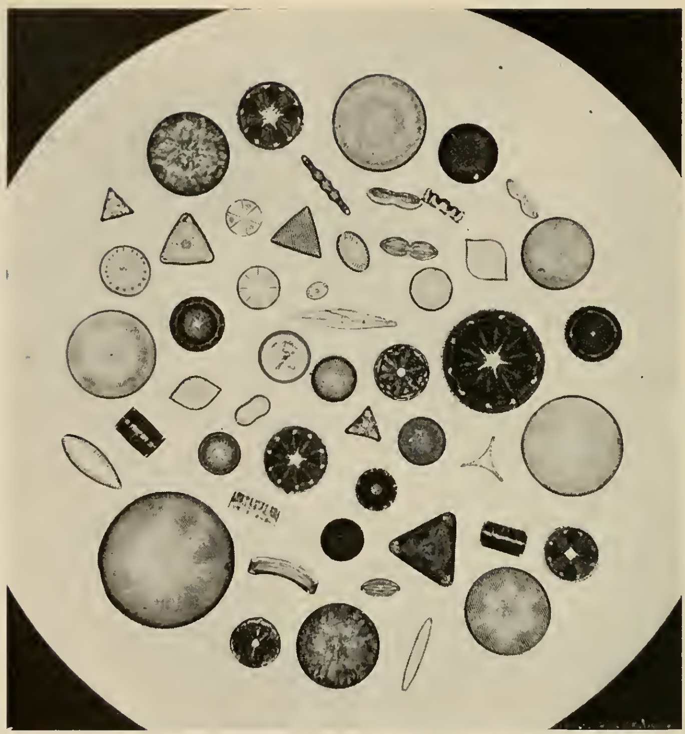


Above is shown a protozoan struggle as it appears under the microscope. These creatures are all protozoans, but the two dark figures (Didinium) are attacking Paramecium. Didinium punctures its prey and sucks out its protoplasm

A microscopic view of a bit of an insectivorous plant. This highly magnified view shows a portion of the leaf of sundew, together with a captured insect, which, in this case, is a thrips

Bausch & Lomb

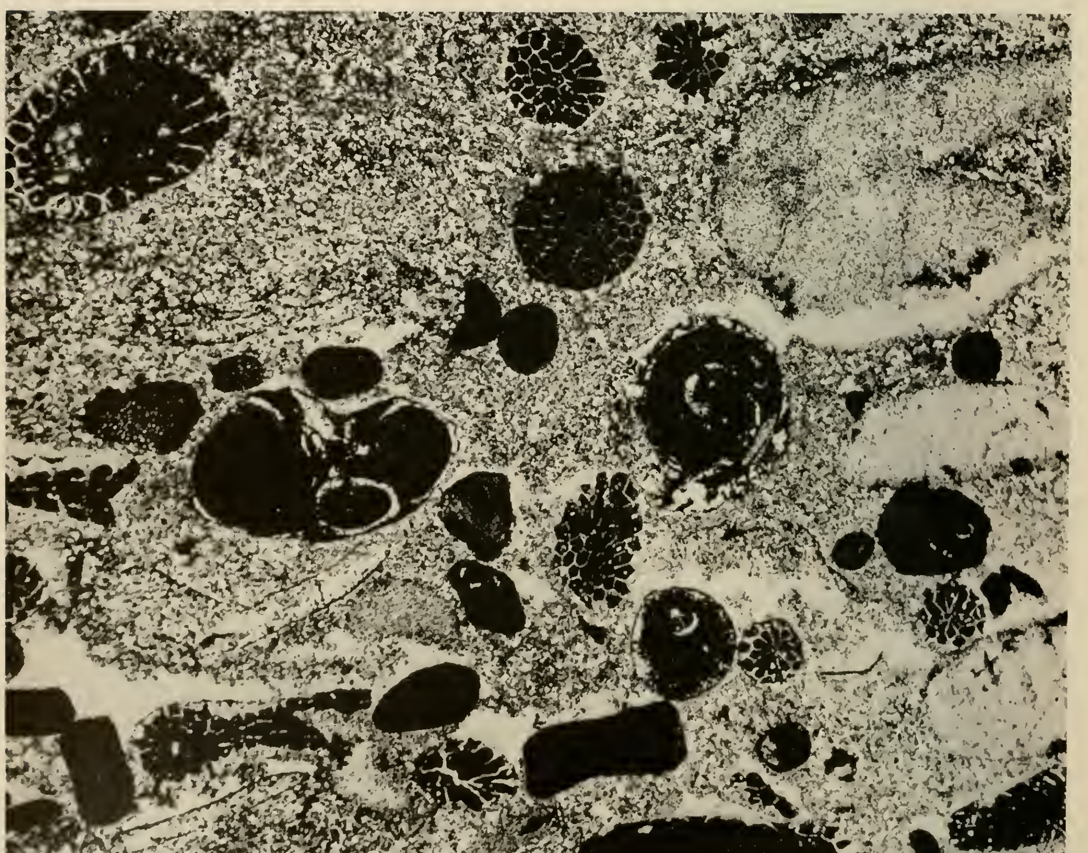




This photomicrograph shows an arranged circle of fifty different species of diatoms. These are one-celled plants that secrete glass boxes to be used as houses in which to live. Among them there is immense variety in size, form, sculpturing, and color. They are a favorite group among amateur microscopists

Photos by Bausch & Lomb

The thin rock section pictured below shows limestone containing many fossil shells of minute protozoan animals — the Foraminifera, of which some limestones are largely composed



water as they are cut. Mount one of your best and thinnest sections on a slide, treat with 10 per cent commercial formalin for ten minutes, rinse in water, stain in safranin for an hour, rinse quickly in 95 per cent alcohol, counterstain with light green for thirty seconds, again rinse in 95 per cent alcohol, clear in aniline oil for ten minutes, and mount in balsam.

Here will be a most interesting picture of the heart of the plant system. Those heavy-walled tubes that take the red stain of safranin constitute the woody part of the stem and conduct water upward from root to leaf. Minerals leached out of the soil will travel in dissolved form in this ascending water. Thinner-walled tubes which have stained green are the sieve tubes and carry food materials downward from leaf to stem and root, feeding the non-productive portions of the plant. Slides like this project brilliantly and photograph well. Practice is essential for the making of good stained sections, but the method is not difficult.

Blood

The next time someone in your establishment cuts his finger, take a clean slide and cover and catch a drop of his blood, covering it immediately and sealing around the edges with vaseline to keep out air. Such a slide will remain in condition for study during an hour or more.

Permanent mounts are made in the form of cover glass films, requiring a bit of dexterity. A drop of blood is caught on one cover glass, a second glass is immediately placed on top of the first, and the two are then drawn apart by slipping sideways, without pressure. Speed is an important essential, it being necessary to prepare a thin, evenly distributed film on the inner surface of each glass with the greatest rapidity to prevent post mortem changes.

Each film is then exposed to the air, drying being so instantaneous that all of the blood cells are fixed in a natural state. Place a blank slide across a small, shallow, glass vessel, which here serves as a miniature sink or waste jar; then lay one of the cover glass films face up on this slide, which acts as a table to support the cover glass. With a pipette, medicine-dropper type, put two drops of Wright's stain on the film and time it to remain one minute. Next add two drops of distilled water to the stain already on the film, and let stand for three minutes. Now drain off this mixture of stain and water and replace with water alone. Mount the slide on the stage of a microscope, so that the process of bleaching which now ensues may be watched and checked. When the red corpuscles have a salmon-red color, drain off the water and blot the film gently with a piece of filter paper. Expose to air for five minutes longer to insure thorough drying, then mount, film side down, in a drop of balsam on a clean slide.

What the Microscope Reveals

Red corpuscles should be everywhere present in great abundance. They are small, circular discs; cells that during development have lost their nuclei in order to function more effectively as flexible bags containing the fluid pigment, hæmoglobin. This substance combines with oxygen in the thin-walled capillaries of the lungs and transports the life-giving gas to all parts of the body. The remarkable chemical interchanges which take place continually in each of the millions of these red cells literally provide for us the breath of life.

Scattered through the field are occasional blue cells of various types, the white corpuscles. The cell substance takes a blue stain, the prominent nuclei a purplish one. Some of them have minute granules that take a bright red color. These corpuscles are the policemen of the body. They are able to leave the blood vessels, pushing through the walls and migrating out into the tissues to fight infection. Like an amœba, they can produce pseudopodia and engulf bacteria or foreign substances and thus, if their fight is a successful one, rid us of invading destroyers.

Yes, microscopy is indeed a revealing and engaging hobby. Study what you will, — soils, textiles, plants, animals, minerals, chemical crystals, industrial products, or criminological evidence, — the microscope is man's chief tool in this age of science. To know nothing of this marvelous instrument is to be out of step with the times.

Down Among the Smokies

A visit to an American mountain range that possesses a distinctive charm

By F. R. Dickinson
President, Chicago Academy of Sciences

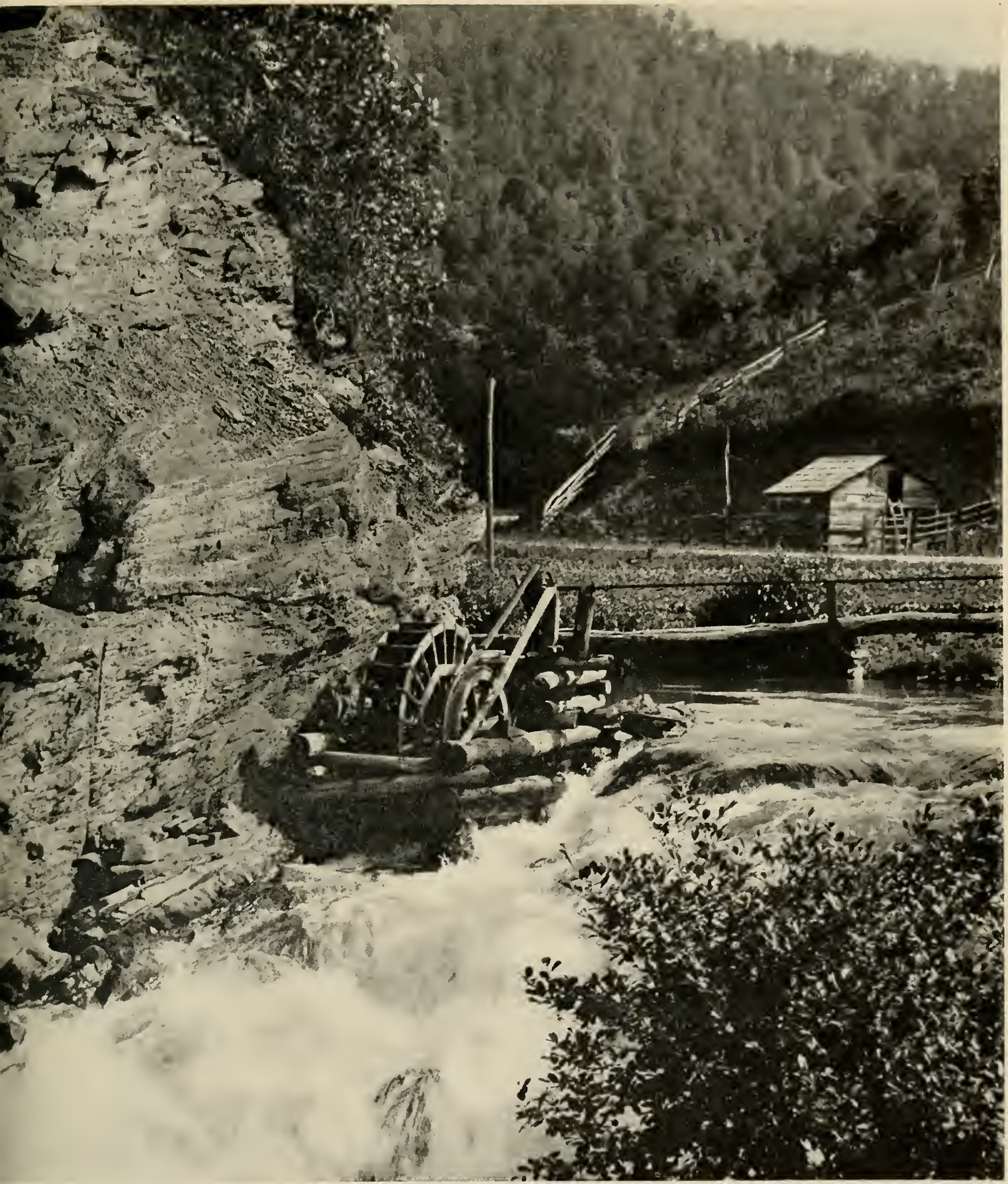
IF YOU like our western mountains and would also like the Great Smokies, you must learn to substitute for the lanky cowboy the gaunt and hospitable mountaineer; for the bucking bronco, the kicking mule; for sagebrush, the rhododendron and laurel; for sudden dust storms, equally sudden rainstorms; and for the six-gun, the long squirrel rifle. Overalls take the place of chaps, and coons of coyotes. It all sounds pretty tame, perhaps, yet there is something about that country —

First for a few facts. The new Great Smoky Mountains National Park contains more than 400,000 acres of mountains, valleys, forests, and streams, part in North Carolina and part in Tennessee. From Knoxville, near the western end of the Park, a straight line about 650 miles long will reach New York; others, about 500 miles long, will reach Philadelphia, Buffalo, and Chicago; and still others, about 375 miles long, will reach Washington, Pittsburgh, Cleveland, Toledo, St. Louis, and Memphis. In other words, only one or two days of easy driving lie between this natural playground and most of the larger cities of the East and Middle West. From the Southeast, of course, it is even more readily accessible. Authority for its establishment was extended by Congress in 1926, with the proviso that no general development could be undertaken by the National Park Service until a minimum of 427,000 acres, within designated boundaries, had been acquired. Through the generosity of the states of North Carolina and Tennessee, of certain private citizens of those States, and of the Laura Spelman Rockefeller Memorial, the development of the area is now assured.

Here, according to official account, one can see the largest virgin hardwood forest and the largest virgin forest of red spruce in the United States. Nowhere else in the world, according to the same government bulletin, is there in an equal area such a variety of plant life, included in which are 152 varieties of trees. Among the larger species are hemlock, buckeye, chestnut, and tulip tree. Specimens of the last named, having a diameter of ten feet and a height of 190 feet, have been found.

Some years ago a blight destroyed many of the great chestnut trees, but with a warm climate and a rainfall said to approach one hundred inches a year, root sprouts are springing up with amazing rapidity. This lavish supply of moisture no doubt accounts in part for the beauty of these forests at all seasons; for in winter it helps to coat the evergreens with a filigree of frost, in spring and summer it supplies a verdancy to the new growth not seen in northern woods; and in fall, it may explain why the leaves, full of sap and vigorous to the end, flame at the first touch of frost into an incredible brilliance of yellow, gold, and crimson. Possibly the humidity due to rainfall may have something to do with the startling blueness of these mountains, even when in full sunlight and at no great distance. This seems not to be caused by ordinary haze, — distant objects are generally clear, — but is a pure, translucent color deepening in tone as the landscape recedes, and adding immensely to the charm of long views. Though at times the higher ridges are blurred or hidden by mists such as rise in any mountainous region, it is these blue or purplish distances which must have given the mountains their name.

Not less interesting than the big timber are the shrubs and wild flowers, which have drawn to this region botanists from many parts of the world. Spring opens early and even in midwinter the rhododendron and mountain laurel are green against the snow.



H. Armstrong Roberts

Smoky Water

The Smoky Mountain National Park is a country of contrasts, of steep mountain slopes, dense forests, rushing streams, and rocky cliffs. The homesteaders with their water wheels, crooked rail fences, and slab houses are typical of the region

Ewing Galloway

Smoky Mountain homes often cling to a hillside amid the ever encroaching forest

Rich valley soils produce vegetables in quantity which tide the mountaineer over the winter

H. Armstrong Roberts

Not all Smoky streams are bridged; some are mere fords, hardly passable when the water is high

Ewing Galloway

Smoky Mountain residents are of pure American stock, but their living conditions are practically the most primitive in the nation. The picture below shows a typical mountaineer's cabin. These dwellings are often miles apart, with rough mountain trails between houses

Ewing Galloway

By May or June they and the azaleas cover the slopes with sheets of bloom, — white, pink, rose, lemon-yellow, and red. From March to November smaller plants, both annuals and perennials, provide a pageant of flowers which for variety and profusion rival those of the Rocky Mountains. Local flower enthusiasts tell us that hepatica, bluets, violets, wood sorrel, and bloodroot, starting the procession, are followed in April by trailing arbutus, bluebells, phlox, golden ragwort, and meadow rue. A little later come iris, bleeding heart, yellow-eyed grass, silverbell, trillium, columbine, Dutchman's breeches, wild geranium, and lady's slippers. By June, daisies, spiderwort, beardtongue, and puccoon are in bloom. In July come butterfly weed, passion flower, black-eyed Susan, lilies, purple-fringed orchis, milkweed, and star grass. August brings asters, yellow-fringed orchis, turtle-head, mints, betony, St. Johnswood, cardinal flower, and monkshood. And closing the season in September, October, and November are goldenrod, iron weed, boneset, sunflower, gentian, and coreopsis. These are the captains and lieutenants of the floral army. As privates in the ranks there are a host of less striking but no less interesting species.

Animal Life in the Smokies

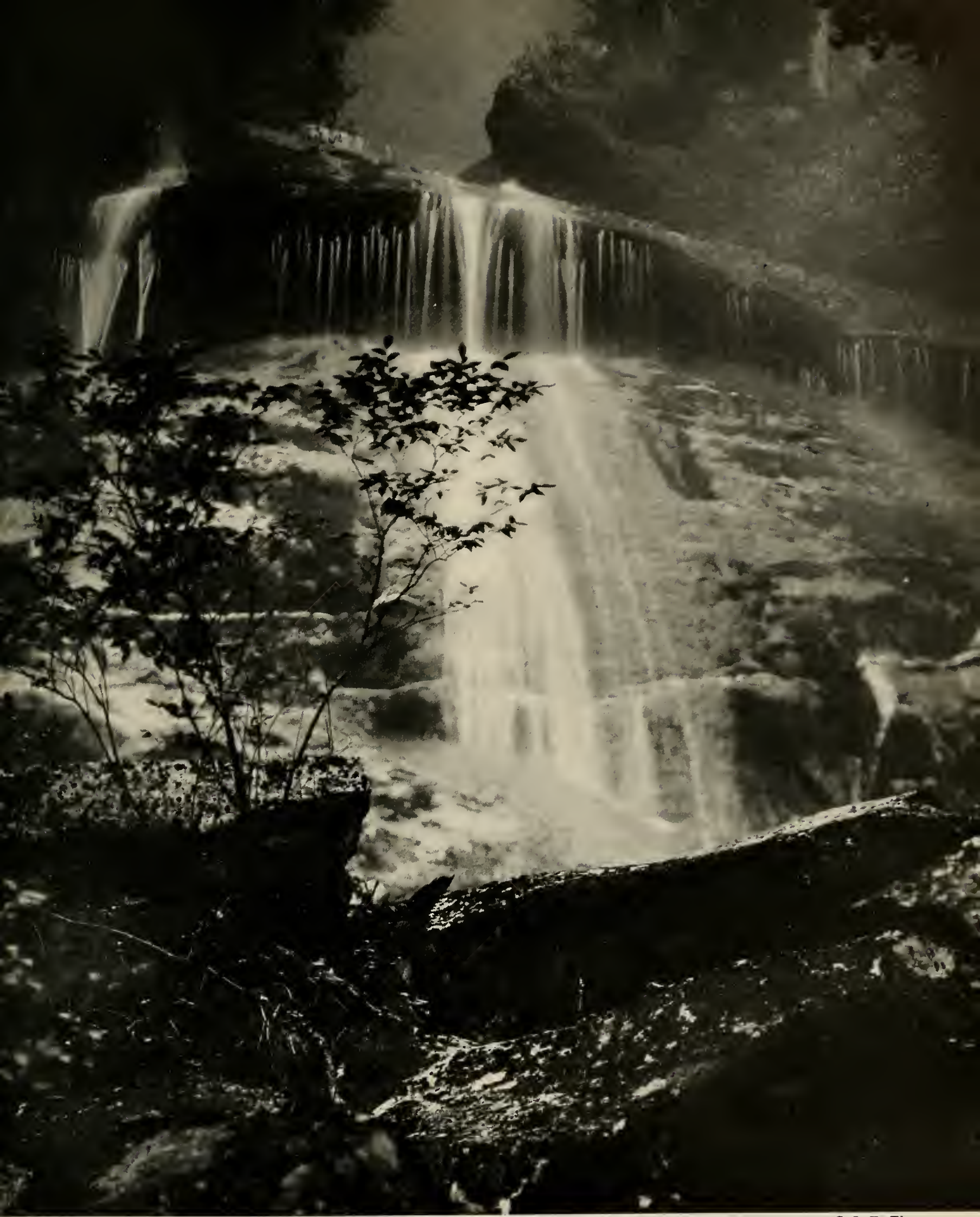
Of mammals, about fifty-four species native to the region are still extant, included in that number being the wildcat, deer, and black bear. Bird life is abundant and of great variety. Both birds and mammals have recently been made the subjects of a faunal survey by field representatives of The Chicago Academy of Sciences, E. V. and Roy V. Komarek who received the full and helpful coöperation of the park superintendent, Mr. C. Ross Eakin, and the chief ranger, Mr. Charles Dunn. The data compiled and specimens collected during a year or more of intensive work indicate that the Park area is a paradise for wild creatures. Not only are migratory birds present in large numbers in spring and autumn, but owing to the diversity of the terrain and of the food supply and the great range in elevation and hence in temperature, a surprising number of species remain as winter, summer, or permanent residents.

Scattered in remote little valleys are clearings where mountain families live in primitive fashion, tending a few acres of corn and potatoes, raising a few hogs and chickens for home use, milking a cow or two, — almost as close to nature as the birds and animals they used to hunt. So weathered and innocent of paint are their cabins that they merge with the surroundings almost as completely as if they had grown there, no more obtruding upon the landscape than worn outcrops of rock against a hillside.

It is worthwhile to talk with these slow-spoken, soft-worded mountain people, lacking in book learning, resistant to the ways of the outer world, but steady-eyed and steady-minded, observant, thoughtful, and deeply attached to their homes. Though some have moved away since the Park took over their small holdings, many others, loath to leave the scenes of their youth, are staying on with the consent of the authorities. No longer allowed to hunt for a living, they find seasonable employment on trails and roads and continue to raise garden truck and children much as they have always done.

In names and features their Anglo-Saxon origin is often apparent. Their forbears drifted into these coves on the eddies set in motion by the opening of the West, found life to their liking, and watched their more restless contemporaries move on to broader fields. Inevitably since those early days, there has been much intermarriage between related families, but to the casual observer there is little physical evidence of harmful results. It is said that in one school, now abandoned, eighty out of a hundred pupils bore the same name, yet such information as is obtainable points to no higher percentage of feeble-mindedness than might be found in any country community.

Feuds exist, though apparently not as commonly or virulently as in some of the other mountainous parts of the Southeast. To strangers, hospitality is as unstinted as it is simple. If nothing more elaborate is at hand, a cup of spring water is offered to the passer-by with a cordial invitation to sit awhile and pass the time of day. Among



©J. E. Thompson

Dome

Cascades

Roaring Fork Creek, on Mount Le Conte, traverses some of the most beautiful sections of the great Eastern National Park of the United States. Visitors to the region marvel at the diversity of scenery along the way

© J. E. Thompson

A sight never to be forgotten — the Smokies as they appear in winter from the top of Mount Le Conte

In early spring the Smoky Chimney Peaks are a mass of flowering rhododendron. At the left is shown one of the highest of the Chimney Peaks

Ewing Galloway

© J. E. Thompson

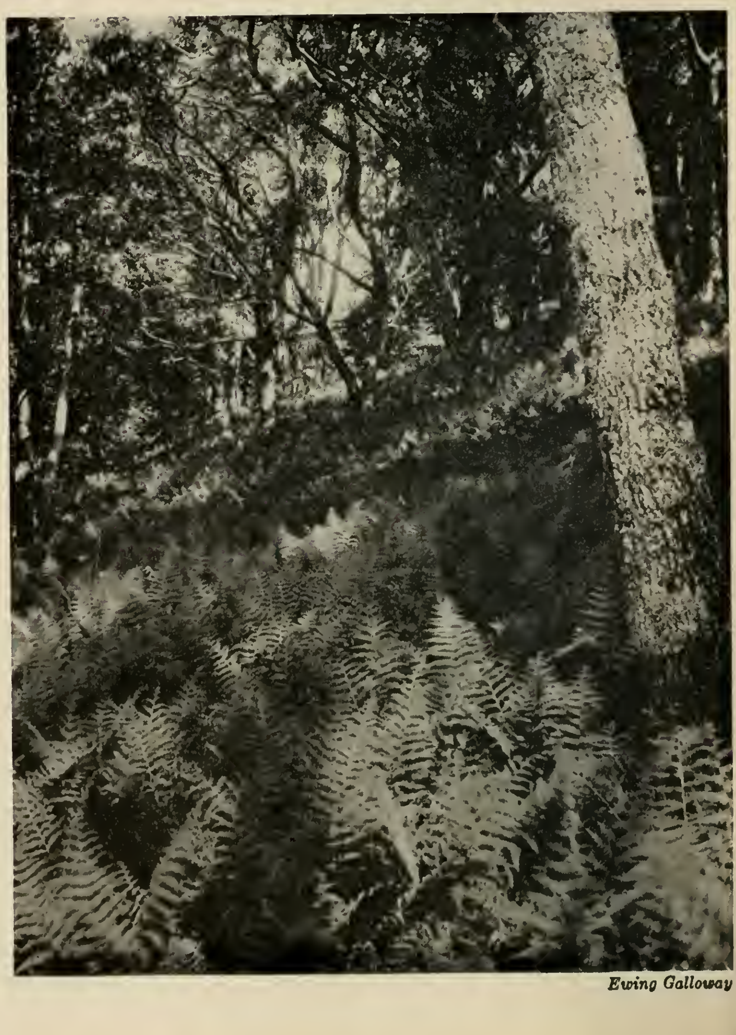
Long mountains, with masterful, yet graceful slopes stretch to the horizon wherever one may turn

Hikers on the trails of Mount Le Conte never fail to pause beside Rainbow Falls, where constant moisture produces a luxuriant plant growth

Ewing Galloway

© J. E. Thompson

Another view on Roaring Fork Creek. Cascades are frequent as one travels on Smoky trails



Upon the mountain slopes the rainfall is heavy and the forest undergrowth is rich in variety and interest. Tall, stately ferns delight the eye

Ewing Galloway

the exceptionally prosperous, the standard of living is higher than might be expected. In one farm home, of blessed memory, fourteen kinds of food, not counting jelly and preserves, were set before the bewildered traveler. Only the mountain habit of putting everything on the table at once enabled him to grasp the situation in time, plan a campaign, and eat his way to a successful finish.

In most localities the cabins are too far apart to permit of much sociability during the week, but on Saturday and Sunday a good deal of visiting goes on, often to the accompaniment of guitar and banjo. Of the songs, many are old, and most of the favorites are plaintive — the musical expression of a people who do not try to cover the essential sadness of human experience with a veneer of frivolity. Among the ones most favored seem to be "Twenty-one Years," "Sorghum Molasses," "The Fifty-cent Piece," "The Faded Picture on the Wall," "The Old Pine Tree," and "Bring Back My Blue-eyed Boy to Me."

In some communities the sparseness of the population makes regular church-going impossible, but each year, usually in May, local meeting-houses, which may have been closed most of the year, are opened for memorial services attended by many former residents of the neighborhood who have moved away long since. For days beforehand the women and girls busy themselves in making paper flowers, less beautiful, no doubt, than the wild ones to be had for the picking, but a surer proof of remembrance for the dead. After a brief and sometimes extempore service in the church, the congregation moves to the graveyard, where families join in paying a floral tribute to those members who have gone ahead. On these occasions it is interesting to note the signs of the times among the young. Girls who dress drably enough on working days are as fresh and graceful in Sunday garb as their town and village cousins.

Though some of the old customs are dying out, one finds here and there a pleasant reminder of earlier and simpler days. Corn is still ground between upper and nether millstones, turned by a ponderous, overshot wheel, to which water from upstream slides down through a leaky flume. The mule drags a homemade plow all week and then carries its owner a-visiting on Sunday. This uncertain quadruped, indeed, figures in one of the mountain songs which in its refrain condenses into one line the mountaineer's philosophy of independence:

> He rides a super-six,
> I ride a mule that kicks,
> Nobody's business if I do!

Everywhere in these hills are streams. In the higher reaches where fishermen have not waded them too faithfully, they are well stocked with trout; and in the quieter waters of the valley bottoms old men who have time to sit in the shade through long summer days keep their family larders supplied with bass. Whether or not one cares to fish, there is no better way to enjoy a ramble than to trace one of the smaller brooks from mouth to source. Often in its lower course you will find it accompanied by a back-country road winding upward, now hugging a steep bank overgrown with flowering shrubs, now scrambling up a rocky gully, now meandering through an open cove where every rotting fence post is festooned with honeysuckle.

If you have been well advised, you will pack a light raincoat on an all day trip, for though at morning the sky is usually serene, by noon masses of cloud may be wheeling through the gaps and hanging ominously over the summits. By two o'clock you are in the midst of a deluge, or if luck is with you, are merely watching one a mile away on the other side of the valley. Half an hour later, the sky is clear, every spray of laurel and azalea gleams in the sun and the air is soft with the odor of damp loam and spring flowers.

As you take the easy downward path toward home you wonder whether the people who live in that tumble-down cabin near the trail understand better than most of us what Shakespeare meant when he wrote:

> And this our life, exempt from public haunt,
> Finds tongues in trees, books in the running brooks,
> Sermons in stones and good in everything.

The next time you get restless, look up the road map and see how long it would take you to drive to the Smokies.

A Unicorn's Horn

The horn of an Indian rhinoceros now in the American Museum which, in 1590, was presented as a unicorn's horn to Pope Gregory XIIII

By Dorothy L. Edwards

If a physician of today were to recommend to his ailing patient a dose of pulverized sea serpent's tooth, the prescription would doubtless be considered a preposterous and impossible one. It would, however, be entirely comparable to one that was very much in vogue among the best people several hundred years ago.

The unicorn for many years held a position in the minds (and hearts) of men similar to that of the sea serpent. Like that popular but elusive monster of today, it was from time to time seen and described by certain favored mortals, and occasionally parts of its anatomy were discovered, but closer to one than that, man was not destined to come.

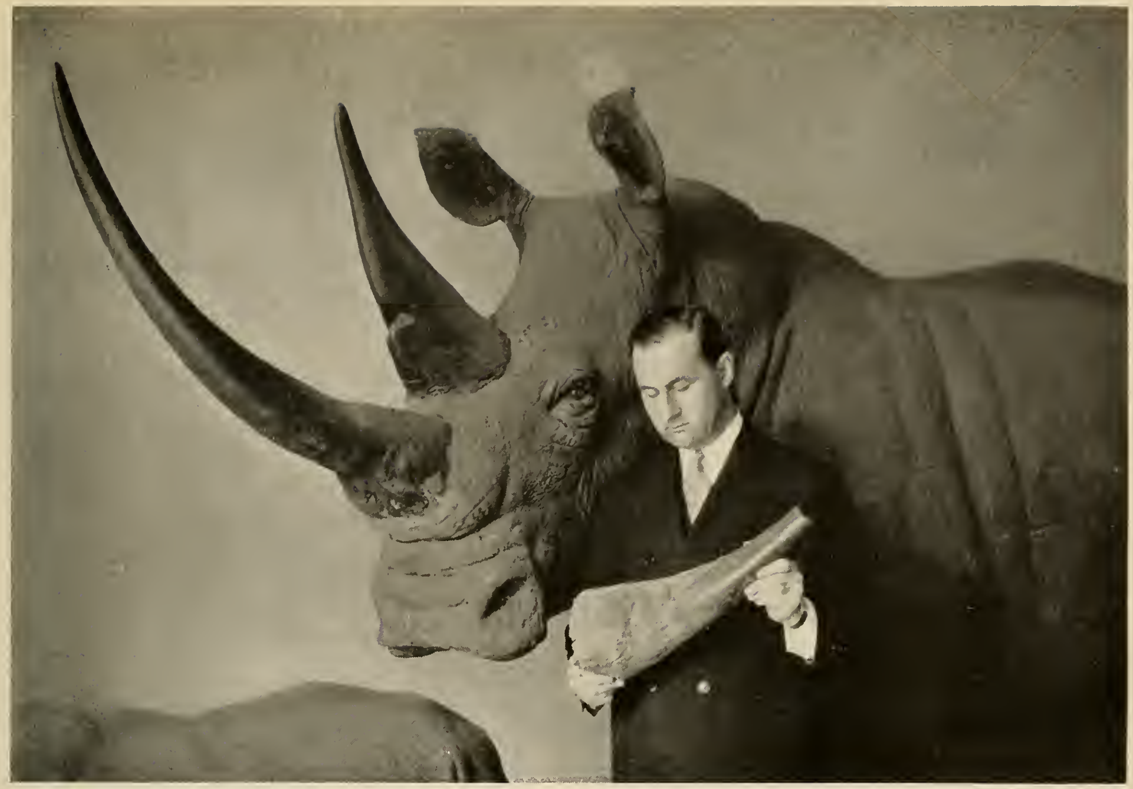
The one feature consistent in unicorns was a horn growing from the center of their foreheads, from which, of course, their name was derived. There were, however, variations concerning the style of this horn. Originally the spiral and comparatively slender tusk of the narwhal was the inspiration for the unicorn, but the more cumbersome horn of a rhinoceros at times was also claimed to have come from the elusive beast.

There was a practical side to discovering a horn that could pass as having come from a unicorn, for in the Middle Ages a doctor could prescribe nothing more potent, nor more expensive, than a piece of ground unicorn horn. If the patient died despite, or because of, this admirable remedy, alibis were doubtless easy to produce in protecting its reputation. There was one thing that kept its use from becoming common — the price, which ranged anywhere from $12,000 to $150,000.

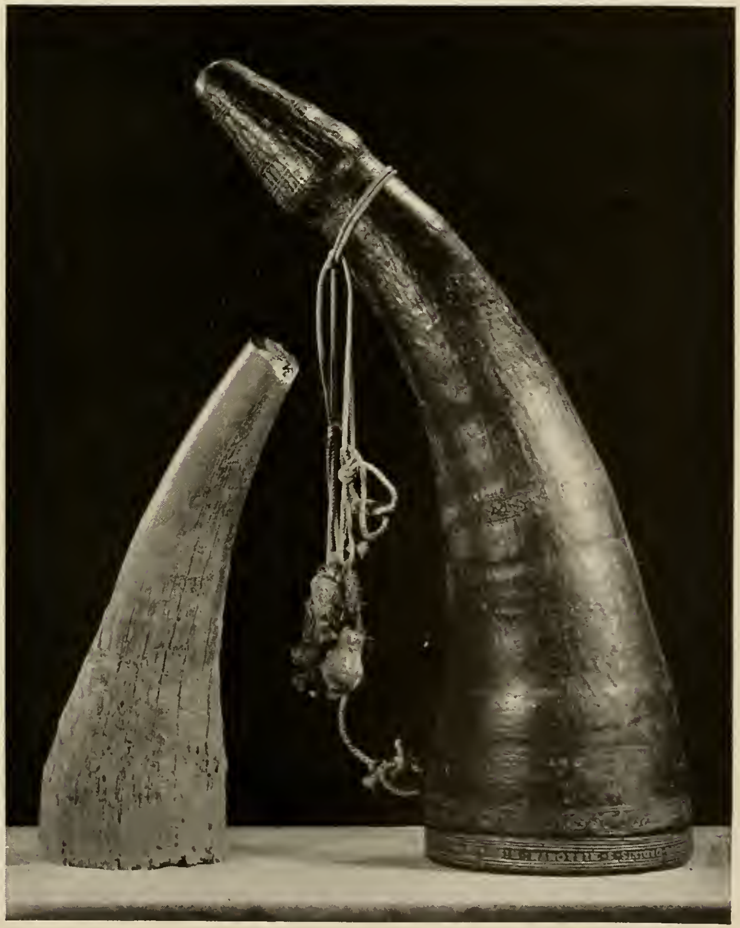
A gift of great value, therefore, was the "unicorn" horn presented to Pope Gregory XIIII by the Prior and Brothers of the Monastery of St. Mary Guadalupe, Spain, in 1590. In reality it was the horn of an Indian rhinoceros which, enclosed in a handsome leather case, was sent to Pope Gregory, who at the time was known to be in feeble health. How the horn of an Asiatic mammal fell into the hands of the Spanish monks is a story which gives the imagination fascinating material with which to play. At any rate there is no doubt that both the monks and Pope Gregory valued it highly. During the last stages of Gregory's illness, the tip of the horn was powdered and administered to him, but to no avail. If for no other reason, however, the gift was worth while, because of its case, which is of fine leather, embossed in gold, and carrying on the cover an elaborate inscription from its donors. Today, despite the tiny worm holes that mar the original smoothness of its surface, it is still a thing of beauty.

It is interesting to realize that in China, even now, the horn of the Indian rhinoceros, under its true name, reputedly has great medicinal value. In fact the species represented by this ancient horn is today practically extinct because of its popularity for this purpose.

In 1909 Pope Gregory's "unicorn" horn was brought to light and offered for sale, at which time it was purchased by Dr. L. Pollak of Rome. Some time later it was obtained from him by John L. Marshall who, in turn, presented it to the American Museum of Natural History. Here, after its several hundred years of adventure, the rhinoceros horn may now be seen in the Hall of South Asiatic Mammals, once again in the environment to which it belonged before circumstances cast over it the glamorous appellation of "unicorn."



The ancient horn of an Indian rhinoceros, which came to be known as a unicorn's horn, being examined at the American Museum of Natural History, where it is now on display. In the background is a mounted African rhinoceros



The unicorn's horn that once belonged to Pope Gregory XIIII, and the handsome leather case in which it was presented to him by the Prior and Brothers of the Monastery of St. Mary of Guadalupe, Spain, in 1590. The missing tip of the horn was administered to Pope Gregory during his last illness

Science in the Field and in the Laboratory

American Museum Activities, Expeditions, Education, Meetings of Societies, and New Members

Edited by A. KATHERINE BERGER

Morden Expedition for Hawaiian Fishes

An almost endless number and diversity of species of marine fishes occur about the reefs and coastal waters of the Hawaiian Islands. Many of them are of bright and bizarre colors, and do not fail to interest visitors to the aquarium in Honolulu. Color plates published by the United States Bureau of Fisheries have made Hawaiian fishes known to a wider public. The present winter Mr. William J. Morden, a field associate of the American Museum, will be in the Hawaiian Islands three months to obtain material there for the department of fishes of considerable importance in two research problems this department has in hand, the changes with age in fish known as crevallys as bearing on the relationship of the different species, and the number and relationships of different flying-fishes in the Pacific. — J. T. N.

Scientific Study in Polynesia

Christmas greetings to colleagues in the American Museum started on their way from Tahiti on November 22 from Dr. James P. Chapin, who, with Mr. Templeton Crocker, Dr. H. L. Shapiro, and Mr. F. L. Jaques sailed on September 15 from San Francisco to collect scientific material from southeastern Polynesia. At the time of writing, the expedition had worked in the Marquesas and Tuomotus, completing about one half of the material necessary for the bird groups which are planned for the American Museum. The party expected to sail eastward again toward Easter Island and Valparaiso.

Sage West China Expedition

A letter from Mr. T. Donald Carter of the department of mammalogy at the American Museum, dated November 12, 1934, Cheng Wei, Szechwan, says that the expedition was to move on to Maomogou in a few days. This region is supposed to be good hunting ground for takin, and both the panda and the golden monkey are found there. This is to be the expedition's last permanent camp, for they are planning to reach Chengtu on their return by December 15. They now have 1396 mammals and 233 birds.

* * *

As this note is being prepared for press, word comes that on December 11 a cable was received by Mr. Sage's father that the expedition had secured a panda.

The American Museum-Vernay-Hopwood-Chindwin Expedition

Mr. Harry C. Raven, associate curator in comparative and human anatomy at the American Museum, arrived at Rangoon January 5, where he was joined by Mr. Arthur S. Vernay, who flew from London. The expedition left several days later for Mandalay on its way to Mogaung and Chindwin River.

Nova Herculis

One of the most interesting astronomical events in recent years is the flaring-up of the so-called "new star," Nova Herculis 1934. Occasionally it happens that a faint star, for some reason not well understood by astronomers, suddenly increases very rapidly in magnitude or brightness, and it is then called a "nova" or a "new star." Nova Herculis was formerly a star of 15th magnitude, too faint for the naked eye and visible only in large telescopes. About Christmas-time it had increased to first magnitude, and had become one of the twelve brightest stars in the sky. The explosion which astronomers believe was the cause of this increase in brightness of Nova Herculis occurred some 1500 years ago, and the light of this disturbance is just reaching us today, as this star is distant from us by approximately 1500 light-years. The nova can be seen in the morning sky between the bright star Vega, in the constellation The Lyre, and the head of the Dragon. It is about eight degrees from Vega, to the left and a little above this star. Nova Herculis is probably being carefully observed by more astronomers at the same time than any other star in history, since this is the first brilliant nova which has occurred since certain very important developments in astronomical apparatus.

Astronomical Address

At the Annual Meeting of the American Association for the Advancement of Science held in Pittsburgh at the end of December, Dr. Clyde Fisher spoke before the Astronomical Section of the group, on the subject, "The Hayden Planetarium." The Astronomical Section met on this occasion in the Allegheny Observatory.

Dr. Fisher attended the meeting of the American

Astronomical Society which was held in Philadelphia at the Fels Planetarium from December 27th to 29th inclusive. Miss Dorothy Bennett and Miss Marian Lockwood also attended these meetings.

The Hayden Planetarium

Work on the Hayden Planetarium is progressing most satisfactorily, and present conditions seem to indicate that the building will be open for demonstration to the public early in the summer. All the outside brick-work is completed, and it is expected that within about six weeks the stainless-steel inner dome will be installed. This dome is to be perforated with tiny holes. Passing through these holes, sounds are absorbed by a layer of mineral cork in the space between the steel dome and the concrete dome which lies just outside this. This prevents the difficulty of echoes — a difficulty which is a serious one in a room with a hemispherical dome.

Amateur Astronomers Association

During February the Amateur Astronomers Association holds two meetings on its usual Wednesday nights. On February 6 Dr. R. E. Lee will speak on "This Wobbling World," and on February 20 Mr. Stansbury Hagar will speak on "Constellations of the Mayas and the Mexicans." Anyone interested in attending these lectures is most cordially invited to do so, as they are free to the public. Those wishing further information concerning the various activities of the Association may write to Miss Marian Lockwood, Secretary, Amateur Astronomers Association, American Museum of Natural History.

Astronomy Broadcasts

The Amateur Astronomers Association is on the air again, on Tuesday afternoons from 3:30 to 3:45, over Station WOR. On February 5 Mr. Charles A. Federer, Jr., will speak on "The Radiation of the Stars"; on February 12 Dr. Clyde Fisher will speak on "The Progress of the Hayden Planetarium"; and on February 19 and 26 Miss Marian Lockwood and Mr. Arthur Draper will present dramatic sketches describing imaginary journeys to the moon and neighboring planets.

Spring Program, American Museum Educational Lectures

EXCLUSIVELY FOR MEMBERS

Arrangements have been made for three courses of lectures which are exclusively for members of the Museum and their personal guests, namely:

1. Member's course of four lectures in February and March on alternate Thursday evenings at 8:15 P.M. The lectures for February are:

February 14	"Tiger Hunting in the Xarayes Marshes," by Sacha Siemel.
February 28	"Wings Over Africa," by Martin and Osa Johnson.

2. Nature stories for children of members, on alternate Saturday mornings at 10:30 A.M., beginning February 16, when William L. Finley will speak on "Birds, Bergs, and Kodiak Bears."

3. Know your Museum Series. "Jade and the Drummond Collection." This course will be conducted by Herbert P. Whitlock, curator of minerals and gems, and will constitute an extensive study of the Drummond Collection of carved jade, amber, and ivory. The first two of these talks and walks will take place at 8:15 P.M. o'clock on March 5 and 19 respectively.

COÖPERATION WITH COLLEGES AND UNIVERSITIES

The latest development in the coöperation with the colleges and universities of New York City is an arrangement for conducting two courses by member of the American Museum staff exclusively for Hunter College, for which the lecturer will receive the customary fee paid by the College. The courses include one on "General Astronomy," conducted by Dr. Clyde Fisher, and one on "Physiology and Health," conducted by Dr. G. K. Noble. The former course will be given at Hunter College, the latter at the American Museum.

These courses are being undertaken at the request of Hunter College, through Prof. E. B. Cohen, director of evening and extension sessions.

In addition to the above-mentioned courses, the following are being given in coöperation with Hunter College and the College of the City of New York, for each of which college credit is allowed; also alertness credit is granted by the Board of Education. Admission to these courses is by registration through either Hunter College or the College of the City of New York. They are:

"Nature Study for City Teachers," by Farida A. Wiley.
"The Museum in Elementary Social Studies," by Grace Fisher Ramsey.
"Mechanics of Visual Instruction," by L. Wales Holden.

For programs and educational requirements of the above courses, apply to the Department of Education of the American Museum.

Dr. Clyde Fisher will continue his course in "Astronomy for Teachers," given in coöperation with New York University.

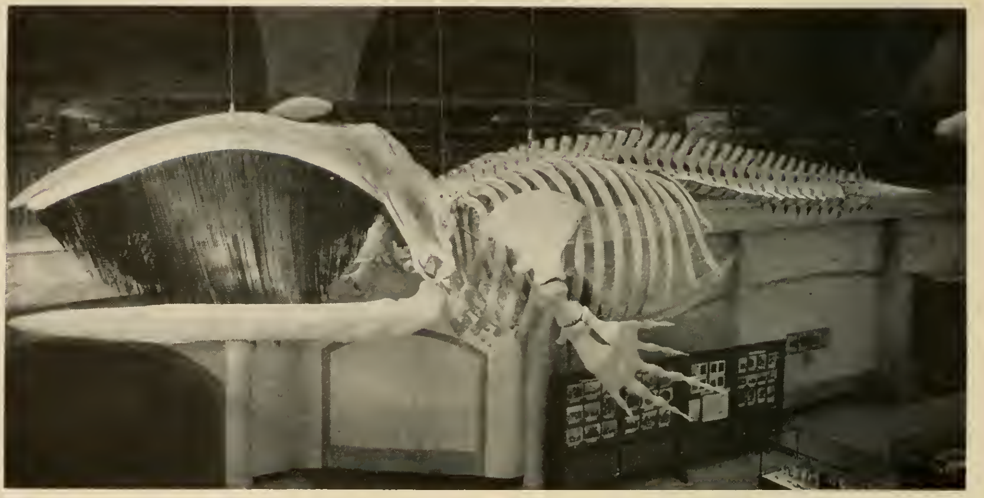
FOR ELEMENTARY AND HIGH SCHOOL STUDENTS

The usual courses for elementary school students are being continued on Mondays, Wednesdays, and Fridays, at 10:30 A.M., and the Friday lecture is repeated at 1:30 P.M.

The department of education will also continue the free lectures on biologic science for high school and college students, during the spring, on Tuesdays at 3:40 P.M. beginning March 5.

EXHIBITION HALL TALKS

The series of exhibition hall talks will be continued, including the "three special activities program" in finger painting, geography crafts, and miniature



From Ocean to Museum Hall

The fifty-four-foot long skeleton of an Atlantic right whale just placed on exhibition in the Hall of Ocean Life at the American Museum

group making. All these classes are given by appointment only.

OTHER LECTURES FOR ADULTS

Curator Whitlock will give a course on "The Cultural Appreciation of Gems," on Saturday afternoons at 4 P.M. during April. Announcement of the subjects will appear in the March issue of this magazine.

A series of five walks and talks on "Primitive Cultures of North and South America" will be given by Georgine Mastin on Saturdays, at 2 P.M., beginning February 9.

The Museum is continuing the coöperation with the Adult Students Association, and a concert program will be presented at 3:30 P.M. on February 2 by the Bronx Symphony Orchestra of the Emergency Relief Bureau Works Division.

The third and final lecture of the series arranged for the Evening Elementary School Students Association will be given by Dr. Roy Waldo Miner, on February 8 at 8:15 P.M. It is entitled "Exploring Beneath the Sea."

FREE GUIDING SERVICE

The free guiding service of general tours of the Museum, conducted by Dr. William Lord Smith, will be continued on Wednesdays, Fridays, and Saturdays, at 11 A.M. and 3 P.M.

RADIO PROGRAMS

The radio programs given by John R. Saunders of the Museum over WNYC at 5 P.M. on Thursdays will also be continued, with tours of the halls on the following Saturdays at 3 P.M.

ACTIVITIES FOR CHILDREN

The Junior Astronomy Club meets the first and third Saturdays at 8 P.M.

The Thoreau Nature Club meets on alternate Saturdays at 2:30 P.M.

Free indoor nature trails for several Museum Halls are available to children.

New Whale Exhibit

After a period of a quarter of a century spent in the storerooms and preparation department of the American Museum of Natural History, a whale that created nation-wide attention at the time of its capture in 1907 has been placed on view in the Hall of Ocean Life at the American Museum. The skeleton, which is that of an Atlantic right whale, is the largest of its kind that has ever been scientifically recorded. One of the unique features of the exhibit is that the baleen or whalebone is mounted in the skeleton. This baleen is a flexible, sieve-like mechanism that is fastened to the whale's upper jaw. Each plate is about 6 inches wide and almost 6 feet long.

The whale was caught off Amagansett, Long Island, on Washington's Birthday, 1907, by a whale boat commanded by Capt. Josh Edwards, famous whaler and probably the last remaining member of the sturdy seamen who, from 1640 to about 1918, engaged in small boat whaling off the eastern end of Long Island.

The whale is historic, too, in that it was the objective of the first expedition of two men who have since become famed explorers, Dr. Roy Chapman Andrews and Dr. James L. Clark. Working waist-deep in icy ocean water, pounded by the surf and slashed by knife-sharp winds, Andrews and Clark labored two solid weeks in near zero temperature to get the bones out. They came within a hair's breadth of losing one of the most valuable parts of the skeleton, namely the whale's hind legs — or what is left of them after 70,000,000 years of disuse.

Peruvian Mammals

The department of mammalogy of the American Museum has recently received from Dr. Harvey Bassler a very valuable and interesting collection of mammals, most of which were taken in the region about Iquitos, Eastern Peru. Doctor Bassler has resided in that region for a number of years, and in addition to the results of his major interest, which is herpetology, he found time to bring together the mammals referred to. Among these may be mentioned especially a number of specimens of the rare bush dog, genus *Icticyon*, and another dog which hitherto has been recorded only from the eastern foothills of the Peruvian Andes, namely *Canis microtis*.

For a considerable number of years Doctor Bassler maintained his own zoölogical garden at Iquitos and a certain proportion of the animals donated to the Museum comes from that source. The collection is especially rich in monkeys and squirrels.

It is expected that Doctor Bassler's collection will aid very materially in settling the status of many Eastern Amazonian species and will supplement the large collections of mammals upon which the department of mammalogy is at present working.

— G. H. H. Tate

The Morgan Gem Collection

Following a long established custom, the department of minerals and gems, of the American Museum, early in January distributed the contents of the "gem accession case," containing the important pieces acquired during 1934, in the permanent installation of the Morgan Gem Collection. During the year so much has been said of the supremely important gift to the department of the Drummond Collection, that the readers of Natural History are in danger of overlooking the fact that the world-famous Morgan Gem Collection is growing constantly, consistently, year by year; and the department takes this occasion to express its appreciation of the generosity of its many friends who have made this growth possible by their gifts. From the magnificent opals of the Lilias A. Betts bequest to the admirably carved Buddha in tiger's eye, the gift of Mrs. Henry Morgenthau, the year's accessions show splendid gains in notable specimens.

It is the hope of the department that the 1935 accession case, now all but empty, will presently equal or surpass in the splendor of its contents that of 1934.

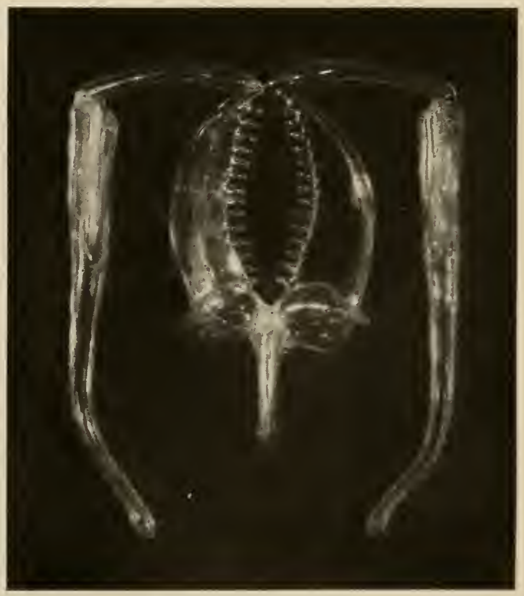
Honors

On January 15, 1934, the Asiatic Society of Bengal celebrated the 150th anniversary of its founding in a special Jubilee Celebration Meeting. Following a precedent of its Centenary Meeting, the Society elected to membership a group of outstanding persons to a class designated as Special Anniversary Honorary Members. At the Centenary Meeting in 1884 six distinguished persons were thus honored, among them Ernst Haeckel, and at the Jubilee Celebration Meeting last January twelve prominent men of affairs were signally noticed. In the list it is gratifying to find the name of Henry Fairfield Osborn included by the Society as an "expression of our greatest respect for your person, attainments and activities." Other scientists elected to membership were: Ernest Rutherford; Albert Einstein; A. Lacroix; and Sven Hedin.

At its annual meeting in Pittsburgh the American Association for the Advancement of Science elected Mr. N. C. Nelson chairman of Section H (anthropology), and vice-president of the A.A.A.A.

Rotifer Jaws

In the laboratory of the department of living invertebrates of the American Museum, Mr. Herman O. Mueller has just completed seven new models of rotifer jaws and a new model of the rotifer *Epiphanes senta*, for exhibition in the Rotifer Alcove of the Darwin Hall. Dr. George H. Childs is at work on a greatly enlarged anatomical model of *Amphioxus*, an exhibit which is in great demand by high schools and colleges.



Throat jaws of a rotifier, enlarged 6000 diameters. With these the rotifier tears to pieces the still tinier animals which form its food

Lindbergh Collection of Spores in Arctic

Collections of micro-organisms which Col. Charles A. Lindbergh made on his flight through the Arctic areas in the summer of 1933, have confirmed previous work in the U. S. Department of Agriculture which indicated that pathological organisms such as those causing plant diseases may be carried long distances — even from continent to continent — by air currents.

Fred C. Meier of the Department has been studying air-borne organisms for several years — particularly those that drive northward over the plains each year to spread rust in the wheat fields. Mr. Meier interested Colonel Lindbergh in making this contribution to the scientific work of the Department, and together they worked out new and improved apparatus for taking samples of the microflora of the Arctic air.

Colonel Lindbergh devised a spore trap which he called "the skyhook," a light, strong contrivance, easy to operate, and well adapted to protecting the sterile glass slides from contamination except for the time they were exposed. Mr. Meier prepared the slides and has examined and photographed them

In his flights between the American mainland and Denmark, by way of Greenland and Iceland, Colonel Lindbergh exposed 26 slides and returned them with field notes and free-hand maps indicating exactly where and for how long, and under what conditions each slide had been exposed. Mr. Meier has taken care of the preservation of the slides; he has been able to identify the genus and in some cases the species of many of the objects trapped in the petroleum jelly which covered the slides. More complete identifications will in many cases have to await the assistance of botanists familiar with the characteristics which identify various kinds of pollen, and of scientific workers who are specialists in different groups of fungi, mosses, lichens. On one slide, exposed far north of the Arctic Circle, Mr. Meier was able to discover under the microscope more than 40 different types of objects in a space five centimeters square. This was on a slide exposed 3000 feet above sea level along the northeastern coast of Greenland.

Mr. Meier and other Department of Agriculture workers, assisted by Army, Navy, and Coast Guard flyers, have done considerable aērial work in trapping spores and other micro-organisms, but this has been over land and in places where it was to be expected that the catch would be abundant. "This Lindbergh collection," says Meier, "is the first of its kind to give concrete evidence of the part played by air currents in the distribution of fungi between northern lands." He points out the possibility that a single living spore which is transferred by the air currents and dropped in a spot favorable for reproduction might create a center for rapid spread of infection.

The Hempstead, Long Island, Skeleton

Master Edward Gorman, while sliding down a sandbank in a vacant lot in Hempstead a few days after Christmas with several companions, had his fun spoiled by a protuberance in the slide, which appeared as a result of the boys' own erosive tactics. The protuberance turned out to be a human skull in a strange iron mask. Police, on excavating, found the skeleton of a person who had been buried tightly trussed in riveted iron bands resembling barrel hooping. The mask around the head was composed of four heavier bars of iron arising from a heavy collar about the neck and joining in a large eye bolt over the crown of the head. To this was attached a heavy eye pin, somewhat longer than a railroad spike, and obviously intended to suspend the whole grisly object from some wooden construction.

Though it was dubbed a "torture cage" by some, the historical authorities agreed that the find represented an example of "hanging in chains" or "gibbeting." The following quotation from the Encyclopedia Britannica describes this adequately: "Formerly in the worst cases of murder it was customary after execution to hang the criminal's body in chains near the scene of his crime. This was known as 'gibbeting.'" Though not part of any legal sentence of execution until 1752, it was nevertheless practised in the Seventeenth Century upon the dead body of the culprit as an added indignity. That the man in this case was already dead before he was encased in iron is made the more probable because it is difficult to see how a living person could have been so harnessed without killing him in the process.

One antiquary suggested that the Hempstead skeleton was that of a pirate come to justice. Another cited the case of a British soldier who, in 1782, entered the house of a Mr. Hedger at night and was shot to death by the master of the house for his trouble, his body being hanged in chains on Hempstead Plains. However, the skeleton itself does not reveal the cause of death. A hole in the side of the head and another in the face are almost certainly post-mortem injuries.

Through the kindness of Inspector Harold R. King of Nassau County the skeleton has been turned over to the American Museum of Natural History, and is now on exhibit in its iron shroud at the main entrance.

As to the individual himself, the whole skeleton, by its robustness, as well as by details of the skull and the pelvis, shows that he was a man and not a woman. That he was a white man and not an Indian is shown by such points as the depressed root of the nose and the absence of great breadth across the cheek bones. That he was probably of just such a north European type as that of the English and Dutch colonists is suggested by the conformation of the brow, together with the fairly long head and face.

His stature cannot actually be measured, since too much of him has been dispersed, but the English biometrician, Karl Pearson, has constructed formulæ by which the height of an individual can be calculated from almost any of his limb bones. Of this evil doer, only the right upper arm bone remains in sufficiently good condition to be accurately measured. The application of Pearson's formula gives a height of approximately five feet and two inches. Furthermore, the skull, though not submedium in size, gives the impression of belonging to a fairly short individual. Though short themselves, the bones are heavy and rugged, showing that in spite of his inferior height, the man was stocky and muscular. His age may be taken to be about thirty, as judged from his teeth and from the degree to which the joints of the skull vault have closed. The only other items that can be added to his personal history are these: his teeth, though not perfect, gave him little trouble; on the other hand, he suffered from a bone infection in the neighborhood of the left eye which probably caused him considerable discomfort. — W. W. Howells

A Bird Sanctuary for New York City

A worthy project has been undertaken by the New York Bird and Tree Club this year, within the city of New York.

Nine acres of natural woodland on the Bronx River, between the new Thompson Memorial Rock Garden and the large Iris plantation in the New York Botanical Garden, early next spring are to be enclosed by a fence, within which birds may find shelter unmolested, and wild flowers and trees of New York will be planted and protected. Birds are to be encouraged to stay over winter by being fed. Entrance to this sanctuary will be permitted only to those people whose honorable interest in wild life is assured.

The idea of the sanctuary within the city limits, where birds and wild flowers are particularly precious, was inspired by the sanctuary created by Mrs. James Baird on the grounds of the Scarsdale Golf Club. This area, established only five years ago, when the Club threatened to cut down a magnificent stretch of natural woods, has already become a haven for many birds, who naturally appreciate this bit of forest preserved for them. The existing growth of the area has been augmented by the planting of some of the finest of the native shrubs and flowers.

The New York Bird and Tree Club, which is now sending out pleas for new memberships and for additional funds to help in constructing the fence which will mean the establishment of the new sanctuary, hopes to make this project as outstanding a piece of work as it did when it raised $12,000 a number of years ago for the replanting of orchards which had been devastated by the war in France.

The sanctuary at the Botanical Garden is to be made a memorial to Mrs. Nathaniel Lord Britton, wife of the founder and former director of the institution and herself an ardent worker for the preservation of wild life. It has been suggested that sections of the fence be dedicated as memorials to others.

Mrs. William Wallace Nichols of Scarsdale is chairman of the sanctuary.

Eventually, the club aims to establish arboretums in other states, beginning with New Jersey, where Mrs. Thomas A. Edison is to be the chairman. But the immediate endeavor of the 200 members is to raise funds for the New York City sanctuary at The New York Botanical Garden in Bronx Park. The Garden itself is offering all possible support and cooperation for this project. — E. D. Merrill, Director, N. Y. Botanical Garden.

Recently Elected Members of The American Museum

A report from the membership department lists the following persons as having been recently elected members of the American Museum:

Life Members

Mrs. Geo. A. Helme.
Mr. Christian R. Holmes.

Annual Members

Mesdames J. Adam Murphy, Estella R. Steiner, Casimir I. Stralem, Henry Alfred Todd, Barton P. Turnbull, Niel A. Weathers, M. S. Weil, Lester Wittenberg.
Misses Clair Freeman, June Freeman, Elsie Kupfer, Therese Thorne.
Doctors Louis Friedman, Arthur S. Litten.
Messrs. Maurice Lauridsen, Jr., Prior Sinclair, Parker A. Stacy, L. L. Stuart, W. S. Symington, Nelson S. Thompson, A. A. Tilney, Clarence A. Warden, David Waterbury, Theodore Weicker, Frederick B. Wells, Gabriel Wells, F. R. Wheeler.

Associate Members

Mesdames Mary Atkinson, Komah G. Atwater, Edith F. Baurle, Eva P. Bennett, Emilia F. Bradford, Allan C. Brown, Annye B. Burbank, Joseph A. Capps, Harvey Denison Cowee, William E. Cuff, Mary Cuddihy Donohue Clare Dowler, L. E. Dunn, Ella L. Durkee, W. G. Elmslie Henrietta M. Flanner, May Graf, C. W. Hackett, Jack Hagar, Samuel P. Harris, John Sherman Hobbs, Waldo Hutchins, Jr., Colin M. Ingersoll, Milton W. King, Louise C. Koons, Freda S. Levine, Etta Loewenbaum, Mary S. Lubin, Ellen G. MacDowall, Gladys M. Mann, May Benzenberg Mayer, Andrew B. McClary, Alfred McCormack, John Taylor Morrison, Thurlow C. Nelson, Willis S. Pryor, Clifford Ridge, Georgie Thurston Rivers, E. F. Rivinus, Ruth Rocker, F. Priscilla Alden Sawyer, Vitalia J. Sharpe, J. K. Smith, Marion M. Sniffen, Marie Ahnighito Peary Stafford, R. C. Stanley, Caroline B. Stephen, Hooker Talcott, John Tannor, S. G. Tate, Sam S. Tenenbaum, Charles Appleton Terry, W. A. Trubee, Gladys M. Tyler, Sophia Van Deusen, Samuel C. Van Dusen, Lew Wallace, L. E. Waterman, Sylvia H. Weiss, Alex. M. Wetherell, A. C. Zabriskie.
Misses E. Abramson, Louise Adamson, Blanche Adler, Mae Alexander, Cornelia W. Allen, Frances Bird, Elizabeth F. Blackman, Beatrice Blakslee, Florence P. Bois, Emma C. Bonney, Flora H. Bradley, Harriet Brownell, Helen D. Campbell. Jane A. Catlin, Dorothy C. Chase, Edith C. Cock, Lillie Davidson, Elizabeth Irene Day, Marie Helen Deacon, Jane H. De Wolf, Mary E. Dialogue, Mary Ellen Donahue, Margaret M. Doyle, Amy Dunning, Ethel T. Dyer, Elsa Ebeling, Alberta C. Edell, Rebekah Elting,

Martha B. Farrell, Mary F. Flynn, Gula E. Gamble, Ruth Gillespie, Edith Gould, Barbara Greenberg, Katharine S. Gregg, Lilian C. Hanson, Elizabeth G. Heinrich, Frances P. Heydt, Margaret E. Hoffman, Emma G. Holze, Charlotte Hubbard, Elizabeth S. Hummel, E. Elizabeth Jones, Gertrude E. Jones, Clara L. Ketcham, Margaret A. Killion, Elena H. Klasky, E. Leonore Kreuser, Virma D. Krusen, Florence T. Latham, Betty Flora Luhan, Jeanette V. Lyons, Lorraine Maynard, Mary E. McDowell, Mary H. Merritt, M. Elizabeth Meyers, Margaret J. Mitchell, Frances R. Moore, Ann M. Mylne, Beulah I. Nadler, Helena T. Newman, Pearl C. Nickelsen, Anna F. Nowlan, Emily Peer, Marie S. Pferdt, Galilee Phelps, May Randall, Ruth Agnes Reed, Anna E. Remmert, Irma Renner, Dexter Elizabeth Jean Richards, Mary Wendell St. George, Margaret A. Schmidt, Charlotte A. Schreiber, Leona Shanberg, Victoria Smith, Ada Solt, Emily A. Steere, Matilda S. Tarr, Edythe A. Weaver, M. Gertrude Worrall.

Rev. Doctors Henry Kendall Booth, Joel B. Hayden.

Reverends John J. Casey, Edmund Randolph Laine, C. P. Losinski, Donald A. MacLean, David McKeith, Joseph B. Scully.

General Milton F. Davis.

Colonel O. R. McGuire.

Major Wm. P. Richards, (U.S.M.C.).

Prof. Doctors J. G. Dusser de Barenne, Caesar Hirsch, K. Staunig.

Doctors C. F. Adams, T. P. Allen, A. Carleton Ambler, Horace B. Anderson, H. L. Apollonio, M. J. Backenstoe, Samuel P. Bailey, E. W. Barton, Albert R. Bickstein, Martin Biederman, Daniel Bohn, Wesley C. Bowers, Richard M. Brickner, Joseph Bronstein, John Edwin Brown, Arthur O. Bruce, Titus Bull, Edward W. Burns, George C. Campbell, Charles P. Chandler, James R. Chandler, Thos. G. Clarke, John F. Cogan, Eugene F. Connally, J. V. Craviotto, Leo. M. Davidoff, Clara L. Davis, Antonio M. de Castro, Everett V. Dulin, Frank K. Dutton, James F. Ellis, Edward Frankel, Jr., Henry Friedland, Edward L. Friedman, Arthur Taylor Gillette, Reid Gilmore, Martin H. Gold, Edw. A. Gorman, Joseph Hajek, John D. Haney, Laura C. Harris, Ella M. Hediger, Charles H. Helman, Solomon L. Hermany, R. R. Janjigian, Nehemiah Janko, M. Kaftal, Ira I. Kaplan, Felix M. Katar, Henry M. Kera, Henry H. Kessler, Samuel Thomas King, Sandford H. Kinne, Wm. A. Kopprasch, William Kruger, Samuel M. Landsman, David Lazarus, Raphael Lewy, John C. Lindsay, Charles F. Lynch, Leonard M. Matthews, E. H. MacMichael, Frank P. Mathews, Humphrey L. McCarthy, William H. McCastline, Gordon Judson McCurdy, Andrew McQueeney, Edward Lee Meierhof, Phillip E. Meltzer, John C. R. Milano, Edward August Muendel, Howard Stout Neilson, Peter O'Shea, R. Townley Paton, J. Kenneth Patterson, Wilmer M. Priest, Arthur Prince, Sophie Rabinoff, Willard C. Rank, D'Artagnan Rivera, Henry U. Robinson, R. E. Rose, A. G. Sacco, W. Warren Sager, A. F. Sava, A. David Schneider, Louis H. Schwartz, James R. Sharp, Robert W. Shearman, D. M. Shoemaker, D. A. Sinclair, Will Cook Spain, Irving J. Spear, Raymond R. Squier, Richard H. Staehle, W. H. Steers, Thomas H. A. Stites, William M. Stone, Homer E. Tabler, E. K. Tanner, Kenneth Taylor, A. H. Thomasson, George L. Tobey, John M. B. Wainright, William Fred. Walenta, Thomas F. Walker, H. W. E. Walther, George Gray Ward, Andrew J. Warren, John E. Weeks, Harry I. Weinstock, F. L. Wells, D. E. W. Wenstrand, W. H. Wesley, William D. Whitehead, Morris Frederick Wiener, F. S. Williams, John Wilson, Thos. L. Wilson, Abr. L. Wolbarst, Max Wolf, William C. Wolverton, Lowell C. Wormley, Frank C. Yeomans, Peter Ivan Zeedick.

Professors Elizabeth M. Collins, Robert Compton Patterson, Fred W. Tanner, C. E. Turner.

Honorable Samuel J. Harris, Malcolm Hatfield, Francis White.

Messrs. W. H. Adams, Jr., W. Espey Albig, Joseph Paul Alvich, George W. Bacheller, Frank Wade Ballard, W. R. Ballard, Louis Beeres, W. B. T. Belt, Clarence F. Bent, C. A. Bethge, Guy H. Bezler, Walter Blackson, Irving G. Botsford, Ted Bottomley, Frederic S. Boutwell, Thomas Brady, Jr., Ben Branch, G. D. Brandon, John L. Brichetto, C. R. Britten, Herb B. Brockett, Ralph M. Brown, Richard DeMille Brown, Walter A. Brygier, James D. Bump, M. L. Burleson, Joseph R. Busk, Jr., Wells H. Button, E. E. Byrd, H. Bissell Carey, H. U. Carnes, F. M. Carter, Theodore E. Casselman, Jr., H. F. Clover, Harrison W. Coley, D. R. Collin, S. J. Condron, W. N. Conrad, Lawrence J. Corbly, F. A. Corbusier, J. F. Cornelius, George J. Cossmann, C. B. Covell, Ben Cox, W. N. Cox, John C. Crangle, Frank M. Cressman, Charles F. Curley, S. Foster Damon, Arthur F. Danz, William Dwight Darrow, Leroy R. Davey, George Millard Davison, Edgar Dawson, Charles S. Dayton, L. G. Dean, Ernest Deans, B. Geo. Dearborn, L. Thomas Decelles, Irwin W. Delp, Edgar C. Denny, Peter Hugh DeVries, Francis A. Dimock, James A. Doubles, Jr., Harry V. Dougherty, Howard W. Doughty, John R. Downing. John C. Duncan, John A. Dunlap, Morton D. Dunning, Albert F. Earnshaw, John P. Eckles, Dean S. Edmonds, John M. Edwards, Martin Egan, Harry H. Elam, T. G. Emmons, John Sigvard Engelsen, W. F. Evans, A. C. Ewald, Bruce F. Failey, Edward Fairbairn, Walburga C. Falkner, Joseph H. Farnham, A. Lincoln Fechheimer, Henry M. Feist, Josiah E. Fernald, E. Irving Fiery, Geo. E. Fulcomer, Harrison Fuller, Austin T. Foster, George C. Foust, Jr., John E. Freeman, H. Dawson Furniss, Joseph A. Ganther, Burgess Wilson Garrett, Walter F. Gast, G. J. Geer, Jr., C. M. Gephart, Nicolas J. Gerold, John H. Gibbud, Benjamin Gilbert, J. Stewart Gilbertson, E. E. Giltner, Michael Gladden, Willis K. Glauser, Howard R. Gleason, W. H. Glover, Jr., Juan G. Godoy, George K. Gombarts, Egbert T. Green, R. H. Green, L. A. Greenley, Clifford Greve, Geo. H. Griffiths, Bernt A. Gronstal, John W. Hagan, George H. Hale, Charles J. Haley, Henry K. Hall, Herbert S. Hall, James Whitney Hall, Henry E. Hallborg, Frank L. Hallock, John Henry Hammond, Hance H. Hansen, Harold Hardinge, Jr., Frazer Harris, Henry E. Hartwell, James H. Hayes, Harold Clark Hayward, A. F. Heath, C. G. Hearn, G. C. Hedrick, George W. Heintz, Charles R. Hendt, E. E. Herr, T. R. Hillard, Robert M. Hillas, Charles W. Hills, Arthur E. Hinch, Fassett W. Hinshaw, David L. Hodgens, Wetmore Hodges, Harry Hofmann, Walter S. Hoke, Edgar Allan Holbein, John F. Hollings, Frank A. Homan, Ralph P. Howard, Irl D. Hudson, C. Edwin Hunter, G. R. Hursh, Curtis Hutton, H. Stanley Hyde, Alvan Hyde, George H. Hyde, August Ihlefeld, Jr., George T. Janicula, F. W. Jenkins, Richard C. Jones, John W. Jordan, Elisha K. Kane, Victor Kassel, Edwin Delamater Kay, George Allan Kennedy, Chas. D. Kestler, Clarence E. Ketelhohn, Henry Kleine, Jr., Chas. E. Knox, Albert Krofft, Arthur A. Kron, Jr., Erich P. Kruss, Lowry Lamb, Jr., Jameson Larimore, Jr., Charles Welles Lawrence, M. P. Lawrence, Karl W. Lemcke, William R. Leng, B. W. Lewis, George Edward Lewis, A. J. Li Pira, Wm. B. Louthan, Wm. B. Lyman, M. A. MacLean, John G. MacVicar, Edward R. Manning, George W. Maxey, Wright McClatchy, Richard K. McClure, Jr., Charles J. McDonough, James L. McIntosh. Richard S. McKinley, Frank H. McMurray, Charles F. Merriam, Frank J. Miller, Max C. Miller, Radford M. Moore, Edward Morrell, James B. Morris, John D. Morrison, I. R. Mort, Paul A. Mueller, E. B. Mulligan, C. R. Nelson, B. W. W. Newhall, G. A. Noyes, A. C. Oakley, James E. Palmer, Edward N. Parker, William E. Parsons, Wm. S. Parsons, Dominic J. Pastorelle, Louis B. Pate, W. H. Patton, W. Glenn Pearce, Howard Pearson, George Pebler, Alonzo Petteys, Frederick Pflomm, C. W. Pfost, Julian K. Potter, Samuel Ralph Powers, Theodore Prahl, John K. Prentice, Carl F. Raiss, Frank T. Raymond, John A. Reed, John S. Reed, Wells C. Reid, Bryan J. Reilly, Joel P. Rhoads, W. F. Rieckhoff, William M. Riegel, Harold A. Ritz, Kenneth S. Roberts, B. D. Robison, Charles E. Rogers, Evart G. Routzahn, Charles B. Rugg, Henry W. Russell, J. R. Russell, Elmo A. Sakel, M. N. Sanders, P. E. Sauer, Murray Sayer, H. A. Schilt, Albert Schoff, Louis C. Senger, W. P. Sevier, Jr., John R. Sharp, John A. Sibley, Charles Sifferlen, V. A. Simmons, George F. Singer, C. Hale Sipe, David B. Skillman, Morris J. Skovron, Harry Spencer Slocum, A. Ledyard Smith, Elmer R. Smith, Franklin C. Smith, K. Harold Smith, W. T. Sampson Smith, George D. Snyder, A M. Sobieralski, Arthur Rusmiselle Miller Spaid, George Spero, Frank Spinney, Willard S. Sprague, P. G. Stahly, Arthur J. Stang, Edward B. Stearns, C. F. Stevens, Richard C. Stoll, Geo. F. Stone, Robert Stone, Joseph A. Stonners, Franz J. Strahm, David M. Straight, Richard Strauss, Raymond B. Stringham, Otto Strippel, Charles A. Suter, Jr., Ernest R. Sutton, Harold G. Swahn. David A. Swenson, William H. Sydemon, Donald Symington, E. G. Taber, Joseph A. Taff, J. R. Taft, William P Tallman, John L. Tatman, J. M. Telleen, Edward Tempel, George A. Tenney, Calvin W. Thomas, Roy C. Thomas, S. P. Thomas, Oscar Tielmann, Walter Tielmann, B F. Tillinghast, F. B. Towne, Chas. E. Townsend, E. G. Townsend, Everard L. Tregear, Daniel Tresun, Harry F. Turtle, George A. Urquhart, C. E. Utt, George E. Van Hagen, Hendrik S. Van Klooster, Reeve M. Van Nostrand, Peter G. Verdicchio, Stephen H. Voorhees, C. R. Voris, H. W. Voss, J. K. Wagner, Merrell P. Walbridge, W. R. Walker, Guy O. Walser, Jr., Wm. R. Walton, Arthur W. Warner, T. W. Watkins, Boyd Watson, Frederick S. Webber, Robert L. Weber, Wm. M. Weber, H. W. Weida, Charles Weiss, Joseph Weiss, W. Weitzenberg, C. Harold Welch, Philip Welles, Douglas B. Wells, Geo. B. Wells, Thomas J. Wenner, Will B. Weston, Henry Wheeler, Leslie Wheeler, Richard Stockton White, Roy S. White, Sylver J. White, Fred S. Whitlock, Howard Joseph Widemann, T. M. Wilder, G. H. Willey, 3d, N. J. Williams, Staunton Williams, Samuel Williston, Prentiss Willson, James R. Wilson, Good Wolfe, Lawrence Wolff, George Wolfson, William L. Wolfson, Raymond Styles Woodard, Irving L. Woodman, R. A. Wright, R. B. Wright, Hugh C. Young, J. Addison Young, 2d, M. T. Young, Charles K. Zaleski, Carlo Zeimet, Frank E. Zelaney, Arthur Ziegelmeier, Ray H. Zull.

Reviews of New Books

Recent Publications for Those Interested in Nature

American Bird Biographies. By Arthur A. Allen, Ph.D., The Comstock Publishing Company, Ithaca, N. Y. Dec. 1934. 238 pp. Illus.

THERE may possibly be other bird photographers who take as fine pictures as does Doctor Allen, but none secures studies that are more significant. Being an ornithologist first, Doctor Allen is not satisfied with mere portrait-snaps. His bird pictures must tell a story.

The twenty lavishly illustrated biographies contained in this handsome volume originally appeared one at a time in the School Department of *Bird-Lore.* They were written in the first person, the bird telling the story.

These are delightful in the extreme, and give highly informative and revealing material on courtship, nesting, and migration, but frankly, this reviewer feels that adults enjoy them more than children. They read the stories and love them. In this day of sophisticated youngsters who lose their faith in Santa Claus at an early age, it is perhaps unconvincing that a bird should talk and possess human thought processes. I would recommend the book unreservedly for adults — and certainly the Junior Literary Guild would not have made it their January selection were it not highly suitable for children.

The birds treated in the biographies are the screech owl, chickadee, house wren, scarlet tanager, house sparrow, herring gull, Baltimore oriole, cowbird, peregrine falcon, canvas-back duck, bluebird, kingfisher, green heron, humming bird, ruffed grouse, flicker, killdeer, redstart, robin, and goldfinch.

Those of us who are worried over the rapid decrease of our raptorial birds would like to have seen the account of the peregrine or duck hawk toned down a little. Certainly this story and especially the first paragraph does the bird no good. The duck hawk is a scarce species with a glamour and an æsthetic value that far overbalances its so-called destructive tendencies. Doctor Allen has attempted to convey this, but has not quite succeeded for we fear most people are too "practical-minded."

It is a novelty to see a publication of Doctor Allen's illustrated with pictures other than his own photographs. Ten full-page wash drawings and ten color plates by Dr. George Miksch Sutton, his colleague, supplement the stories. These are handsomely gotten up with wide gray margins somewhat in the manner of the Fuertes plates of Abyssinian birds.

This is the second of Doctor Allen's books. We hope it is but the beginning of a series of similar volumes. — Roger T. Peterson.

A Scientist in the Early Republic: Samuel Latham Mitchill, 1764–1831. By Courtney Robert Hall. Columbia University Press. 1934. 162 pp. Frontispiece.

THE name of Samuel Latham Mitchill will be found in bronze letters on the walls of Floor I of the New York State Roosevelt Memorial with those of other distinguished sons of the State of New York who were pioneers in the sciences of geology, mineralogy, and palæontology. This New York group, in which Mitchill was an honored member, was paralleled by the Philadelphia group that included the distinguished names of Franklin, Jefferson, Rittenhouse, and Wistar.

In setting Doctor Mitchill into his proper place in American scientific history, the author evaluates his contributions without bias and vividly presents the many-faceted, hence brilliant if somewhat erratic, personality in its own perspective: the man of broad culture and personal charm in private and public contacts; the chemist guiding the great controversy of the last half of the Eighteenth Century, founding a new nomenclature, holding the chair of "chemistry and other arts" at Columbia University; the pioneer in the natural sciences — geology, mineralogy, palæontology — not merely theorizing in an age of theories, but practically applying his scientific knowledge in his country's problems (such as his fight for public health, quarantine enforcement, etc.) and his political influence in advancing science and its activities. Readers of NATURAL HISTORY will be particularly interested to learn that one of the societies developed in this way, the New York Lyceum, grew in its museum phase into our American Museum of Natural History.

This small volume should be welcomed by students of American science and by those who are interested in the American scene of a century and more ago, in which Samuel Latham Mitchill was so important a figure that he may today be rated as an outstanding American scientist. Mr. Hall has added to the value of the work by appending a list of learned societies to which his subject belonged and a bibliography of Mitchill's writings. The volume is attractively published by Columbia University Press. — H. F. O.

Introduction to Human Anatomy. By William K. Gregory and Marcelle Roigneau. Guide to Section I of the Hall of the Natural History of Man. Illustrated. Selected references. 82 pages. The American Museum of Natural History. 1934.

MANY students of biology utilize the halls of the American Museum, and frequently students spend hours copying the details of the exhibits into their notebooks. Various devices are at present available in the Museum for helping the students master these details, but none is more successful than the guide books to the halls. The new Hall of the Natural History of Man has proved of great interest to the general public and an invaluable aid to the students of biology. Doctor Gregory and Miss Roigneau have written a guide book which not only summarizes the data useful to the student, but presents this in such an attractive manner that the pamphlet will arrest the attention of even the most casual visitor to the Museum.

The guide book follows the arrangement in the hall closely. First, matters of general interest are considered. These include the sources of energy and the chemical engine which forms our body. Then the evolution of man and some of his most fundamental features are treated in detail. Lastly, the nervous system and its functions are described. Many photographs of the exhibits in the hall are included, greatly enhancing the value of the book as a source of reference. Gregory and Roigneau's guide book will long remain a standard text concerning human evolution.
— G. K. Noble.

Dynamics of Population. Social and Biological Significance of Changing Birth Rates in the United States. By Frank Lorimer and Frederick Osborn. The Macmillan Company. New York, 1934. Pp. xiii–461.

MR. FREDERICK OSBORN, research associate in anthropology, American Museum, has with Frank Lorimer, just issued an important book on the *Dynamics of Population.* The purpose of this volume is to analyze the population trends among the different national groups in the United States, revealing the differences in birth rate, death rate, etc., with a view to forecasting the relative strength of these national groups in the population of the next century. The total population of the United States is classified in various ways, as by national origins, occupations, and economic status. Also, considerable attention is given to the differences between rural and urban populations. These studies are followed by a review of the physical and mental characteristics of these groups, pointing out variations in intellectual development and social status.

The next important question considered deals with the different reproduction rates among these classes, since it is obvious that those classes having higher birth rates and greater survival rates will dominate. The results of these investigations lead the authors to conclude that, though it is yet to be proven that there are important hereditary differences in capacity, as between these classes, it does turn out that there is evidence of a sorting process by which levels in intellectual capacities are established, and that in consequence, the intelligence ratings for such classes will differ. On the other hand, there is evidence that capacities are inherited and "so a relatively slight increase in the reproduction rate of the groups with the higher average capacity for intelligence, and a relatively slight decrease in the reproduction rate of the groups with the lower average capacity for intelligence, would very largely increase the number of individuals of high capacity, and very largely decrease the number of feeble-minded. Present trends are producing the opposite result."

The remainder of the book is given over to a consideration of the causes for the observed trends in population, the conclusion being that low rates of reproduction among the social groups at the higher levels are the chief factor. However, it appears that economic and social factors play a large rôle in determining fertility, and that the particular kind of family limitation pattern adopted by a social class is the chief determiner. Further, the claim is made that no groups with a high standard of living and with a knowledge of birth control methods can be expected to be permanently self-replacing, unless influenced by social conditions that are distinctly favorable to fertility. After this careful scientific analysis of population and related data, the authors turn to consider the possibilities of social control, suggesting that city planning, enhancing of economic security for young couples, and the development of proper social attitudes and ideals, hold out the greatest promise for such control. — Clark Wissler.

Through Space and Time. By Sir James Jeans. New York: Macmillan Co. 1934.

THE lay reader always welcomes a new book by Sir James Jeans, for this writer has the ability to make the story of science fascinating and clear. He is certainly an outstanding literary scientist. His latest book, *Through Space and Time,* is based on the Royal Institution Lectures of Christmas, 1933, and is composed of eight chapters under the following headings: The Earth, The Air, The Sky, The Moon, The Planets, The Sun, The Stars, and The Nebulæ.

The first chapter, that about the Earth, is largely geological, and Sir James is not a geologist or palæontologist. So, when he states that the dinosaur, *Diplodocus,* is "30 feet high," and that the horns of the dinosaur, *Triceratops,* are "each many feet long," we must make some allowances. And we are sorry that Charles R. Knight's well-known restoration of the Sabre-toothed Tiger is not credited to him.

These and other small palæontological slips do not detract in any serious way from the main body of the book, which is astronomical. The charming stories, dramatically told, of how the various celestial objects have come to be as they are, and the impressive comparisons with familiar objects and phenomena are enthralling. It is with astonishing clearness that he answers the questions that all of us have wondered about.

A few astronomical slips have crept in, such as: the confusion of radius and diameter when comparing Earth and Venus on p. 131; in describing Mars on

p. 142 reference is wrongly made to an illustration of Mercury; the statement on p. 155 that Eros comes nearest the earth, of the asteroids, when both Delporte's Body and Reinmuth's Body were known before this book was written. But these are insignificant mistakes, and do not lead to serious misunderstanding of the main theme of the story.

Sir James himself at the beginning of the first chapter very well summarizes his book when he writes as follows: "As we travel through time, we shall try to . . . show not only the present, but also the past and the future, of the universe. We shall see the sky as it was a million years ago, a thousand million, and possibly even a million million years ago; we shall watch vast colonies of stars, each like the sands of the seashore in number, being born, living their lives, and finally dying. As one tiny incident in the great drama, we shall watch one inconspicuous grain of sand — our sun — being broken up in great turmoil and finally producing a family of planets. We shall watch one of the smaller of these planets — our earth — coming into being as a globe of hot gas which gradually cools, and ultimately becomes a suitable abode for life. In due course we shall see life appearing, and finally man arriving, taking possession of his tiny speck of dust in space, surveying with astonishment the strange universe in which his life is cast, and looking wonderingly and perhaps anxiously and fearfully into the future."

And, again, at the close of the book, speaking of the appearance of life — the greatest mystery of all, he says: "It is very humble at first but gradually increases in complexity until finally, only a few minutes back on the astronomical clock, man emerges, and starts gradually and slowly to climb the long steep ladder of civilisation. Yet only within the last few ticks of this clock has he concerned himself with the meaning of the nightly pageant of the sky. Then Egyptians, Chinese, Babylonians and Greeks began in turn to wonder what it all meant. Only one tick ago the telescope was invented and gave us the means of finding out. Within that one tick almost all I have told you has been discovered, and many thousands of times as much besides. And with our knowledge of the skies increasing at its present rate, who shall say what strange surprises the next tick of the clock may have in store for us?"

— Clyde Fisher and H. S. Rice.

Sails Over Ice. By Captain "Bob" Bartlett with a foreword by Lawrence Perry. Charles Scribner's Sons. 1934. Octavo. 301 pp. Illustrated and with sketch chart of eight voyages inside cover.

THIS is a running narrative by her owner and master of the "Effie M. Morrissey's" nine voyages into northern ice-infested seas in the summers of 1925 to 1933. Captain Bartlett was Peary's sailing-master on his finally successful North Polar expeditions, and is generally recognized as the most skillful (or "lucky") navigator of northern ice today. It seems to be a game played against that cold, remorseless, unreasoning Goliath, the North, full of chances which spell defeat or destruction if not promptly met as they fall haphazard, but a game wherein wide knowledge and experience coupled with quick action and a fighting heart, load the dice in favor of one who loves it.

The ups and downs of the ship on these voyages are recorded, ice avoided, storms weathered, damages repaired, escape from cruel grip of uncharted rocks where she had grounded. Bartlett writes, "The Arctic can be beautiful when it is in the mood, no doubt about that. It can be warm, and pleasant, and attractive. But this isn't often the case, and I don't suppose any one goes into the north to have a pleasant time. It is an adventure pure and simple." In the foreword Lawrence Perry says, "This book is the story of the 'Morrissey' since he has owned her." For the ship herself these voyages have been an adventure story, and for that reason (or because it was what the publisher wanted) such is what we have. Though full of human interest, it is the characters intimately connected with the ship's adventures or those that give them a romantic slant that are featured. The purposes of the voyages are merely brought in sketchily or at random, and there is little material with a direct natural history bearing, though the author is a close observer of natural phenomena and doubtless could write interestingly of them.

However, to those of us who have been associated with the American Museum of Natural History for years, this is no longer merely an institution of learning and education, a fine building, magnificent collections or a public playground. Men who at one time or another have had a part in its manifold activities and purposes remain a very living force in the Museum. Among them Robert A. Bartlett is certainly to be counted, and this comes to mind as we read *Sails Over Ice.* — J. T. N.

Exploring With the Microscope. By Raymond F. Yates. D. Appleton-Century Co. New York. 1934.

HERE is a useful aid for the beginner in microscopy. This is an unpretentious volume in nontechnical language. It is written for the hobbyist who desires to explore the world of microscopic life, but who would become hopelessly discouraged by more advanced books on the subject.

After the first chapter, in which the author discusses the vastness of the microscope realm and prepares the beginner for the surprises that await him, are a number of short chapters answering many questions that might perplex the novice. Different types of instruments are discussed and the merits of each explained. Terms, new to the beginner, are defined in the text.

With the aid of diagrams the writer tells how to build simple but efficient equipment useful in the work.

The beginner is told how to find interesting specimens. He is advised to start on everyday things from about the house and back yard. He is given many hints on adjustment of the microscope and on problems of illumination. If carefully followed, these should save the amateur from many of the pitfalls so often encountered in this work.

In the chapter, "Building an Album of Nature's Wonders," the author tells how to prepare microscope slides. In another chapter called "The Teeming Jungle of Microland," he describes many of the interesting plants and animals to be found in a fresh-water pond. Toward the close of the book there are hints on making photomicrographs and a brief chapter on crystals as observed through the microscope.

Exploring With the Microscope serves its purpose well. It is a useful volume for the beginner in that it teaches him the "A B C's" of microscopy.

— R. R. Coles.

A Preliminary Note on The Reptiles of China

"THE Reptiles of China" by Clifford H. Pope is the title of a new volume which is being set in type by G. P. Putnam's Sons, New York, for the American Museum of Natural History. This volume will comprise Volume X of the series of 12 quarto volumes which the Museum is publishing on *The Natural History of Central Asia.* This series of large volumes constitute the final reports of the Museum's Central Asiatic Expeditions, which were led by Dr. Roy Chapman Andrews during the years 1922 to 1930.

Mr. Pope was a member of the scientific staff of these expeditions. He specialized in reptiles and spent most of his time, while in the Orient, collecting in China. After assembling large collections in various parts of China, he returned to the Museum in 1929. Since then he has spent considerable time studying the collections and some three years in the preparation of his report. He has also had the opportunity to study the Chinese reptiles in the large museums of the United States, England, and those of continental Europe. Mr. Pope's volume is thus monographic in scope and treatment, and should be of great service to those students and laymen who are interested in this phase of natural history. The volume, when printed, is estimated to comprise 628 pages of text, 78 line cuts, 27 full page plates, a folding map, a folding table and an index.

This is the fourth volume of the series of twelve which has been edited and ordered printed. Copy for some of the other volumes has been completed, but not edited; others are in various stages of preparation. Three volumes, I, II and IV have been printed, and may be secured from the Library of the American Museum. They deal with the following subjects: Volume I, "The New Conquest of Central Asia" by Dr. Roy Chapman Andrews, is the narrative account and review of the work of the Central Asiatic Expeditions. Volume II, "The Geology of Mongolia" by Prof. Charles P. Berkey and Prof. F. K. Morris, gives a modern interpretation and description of the geological features of central Asia. Volume IV, "The Permian of Mongolia" by Prof. A. W. Grabau, has to do with the description of the rocks and fossils found in one of the prominent limestone areas of Mongolia. All of these volumes are noted for their abundance of illustrations and the masterly manner in which the subject matter has been handled.

— Chester A. Reeds.

Recent American Museum Publications

AMERICAN MUSEUM NOVITATES

No. 758. Origin of the Segmental Coloration of Amethyst and Smoky Quartz. By Clifford Frondel.
No. 759. Mineral Incrustations upon the Edges and Corners of Crystals. By Clifford Frondel.
No. 760. The Distribution of Rotifera on Mount Desert Island. Part VI. New Brachionidae of the Genus *Lepadella.* By Frank J. Myers.
No. 761. The Distribution of Rotifera on Mount Desert Island. Part VII. New Testudinellidae of the Genus *Testudinella* and a New Species of Brachionidae of the Genus *Trichotria.* By Frank J. Myers.
No. 762. Descriptions of New Birds from Mocha Island, Chile, and the Falkland Islands, with comments on their Bird Life and that of the Juan Fernandez Islands and Chiloe Island, Chile. By Frank M. Chapman.
No. 763. Studies on *Papuina* and *Dendrotrochus,* Pulmonate Mollusks from the Solomon Islands. By Ilse Rensch.
No. 764. New Genera and New Species of Fossil Terrestrial Mollusca from Brazil. By Carlotta Joaquina Maury.

BULLETIN

Volume LXVIII, Art. 2. The Penaeidae of Louisiana with a Discussion of Their World Relationships. By Martin D. Burkenroad.

Are you interested in the great nations which preceded ours in the Western Hemisphere? If so, you will find

Old Civilizations of Inca Land

By Charles W. Mead

A fascinating story of an ancient people who achieved a high degree of culture in the new world before its discovery by the white man. In the study of their architecture, their social and political organization, their religion and ceremonies, their art and their science, you will find the thrill of real adventure.

117 Pages, 55 Illustrations
Bound in cloth
Price $1.10 postpaid

Address orders to The Librarian
THE AMERICAN MUSEUM OF NATURAL HISTORY
77th Street and Central Park West
New York, N. Y.

All payments must be made in advance

VISITORS & MEMBERS
at the Museum

ARE INVITED TO PATRONIZE THE

RESTAURANT

ON THE SECOND FLOOR OF
THE MAIN BUILDING

Operated for the convenience of Members and Visitors

*

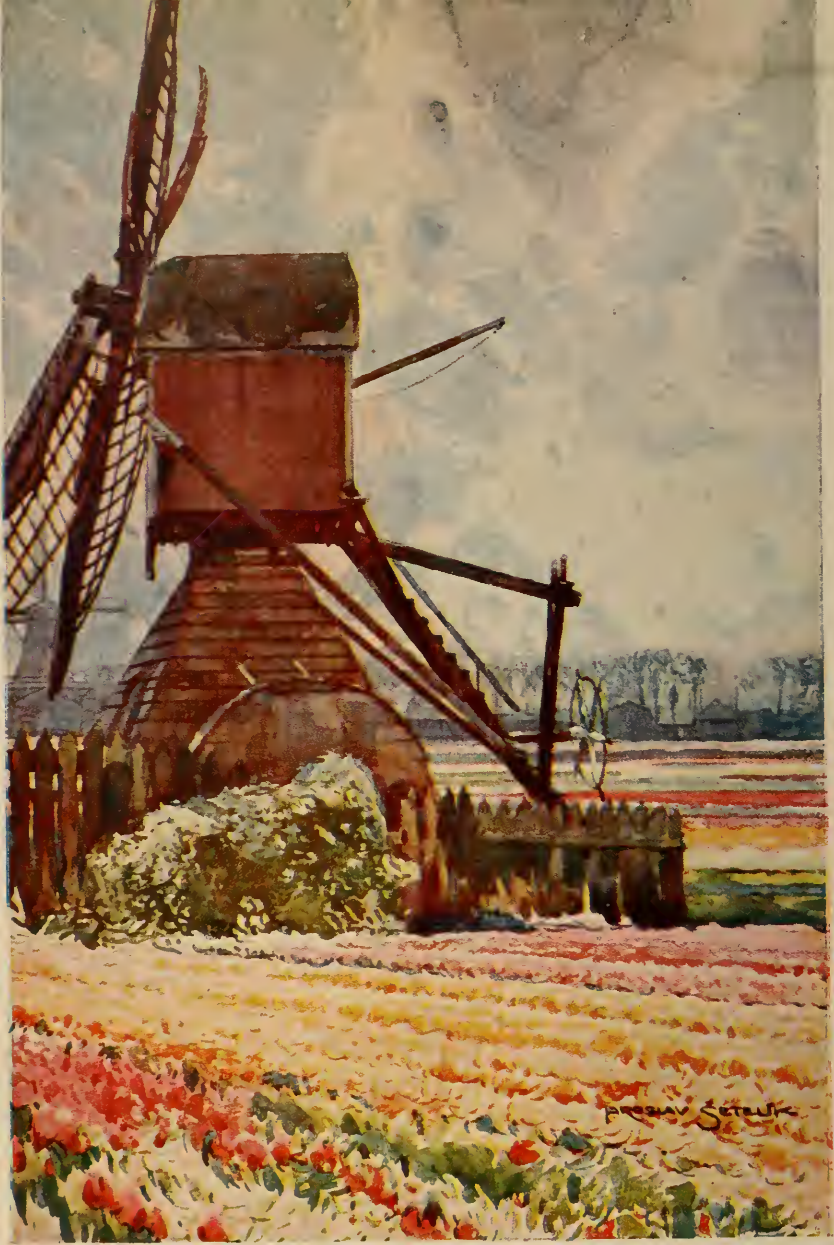
LUNCHEON
11:00 to 2:00 o'clock
40 cents; 50 cents; also a la carte

AFTERNOON TEA
2:00 to 4:45 p.m.

DINNER IS SERVED
on evenings of regular and special Members' Lectures
6:00 to 8:00 p.m.
Price $1.00

*

A VIEW OF THE AMERICAN MUSEUM RESTAURANT



VISIT HOLLAND IN "TULIP TIME"

TRAVEL DIRECT VIA A FAMOUS SERVICE

SS *VEENDAM* WED. MARCH 20
SS *VOLENDAM* SAT. APRIL 27
SS *VEENDAM* SAT. APRIL 20
SS *STATENDAM* TUE. APRIL 30

This year you have an unusual opportunity to visit the magnificent International Flower Show which is held only once every ten years. This year it will be held from March to May at Heemstede, Holland, in the heart of the tulip country.

FOR FURTHER INFORMATION SEE YOUR LOCAL TRAVEL AGENT OR

HOLLAND-AMERICA LINE

29 BROADWAY NEW YORK CITY

NATURAL HISTORY

March 1935
Fifty Cents

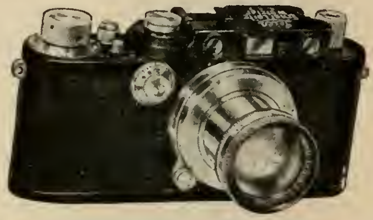
Journal of The American Museum of Natural History

SEE ALL WITH A LEICA

The Modern Miniature Camera

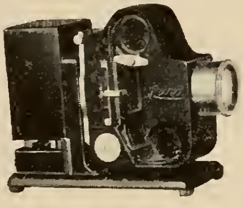
INTERCHANGEABLE LENSES
BUILT-IN RANGE FINDER
FOCAL PLANE SHUTTER
36 PICTURES ONE LOADING
SPEEDS FROM 1 TO 1/500th SEC.

A Camera for the Amateur and Scientific Worker



LEICA with f: 2 SUMMAR
U. S. Pat. No. 1,960,044

There is hardly an expedition which leaves without LEICA equipment. LEICA is used by Robert C. Murphy, H. C. Raven, George G. Simpson, and many others. Use the LEICA for aerial, panorama, stereo, telephoto, color, speed, close-up details, and general photographs.



UMINO Projector

Project LEICA Film or Glass Slides in the UMINO

Show your lecture and demonstration pictures the economical way with the UMINO Projector . . . brilliant images . . . fits a brief case. Operates on 110-volts or 6-volt battery.

Write for circular No. 1230
Also the "LEICA in Science" booklet No. 1206

E. LEITZ, INC., *Dept. 8,* 60 EAST 10*th* STREET, NEW YORK, N. Y.

FOR THOSE WHO CARE WHAT THEY READ . . .

Relating books to life, each issue of *The Saturday Review of Literature* is well-planned, interesting and entertaining. The Review's regular contributors include many of the best of English and American writers. Its stimulating feature articles, intimate profiles of authors, and news of the publishing world combine with independent book reviews to make it not just a review of literature but literature itself. The editors of the Review — Henry Seidel Canby, Amy Loveman, George Stevens, William Rose Benét, and Christopher Morley, lend it both personality and authority. Probably, you would enjoy it. The subscription price is $3.50 for one year (52 issues) or you may take advantage of our special offer of three months (13 issues) for $1.00. *Why not send off your subscription at once to: —*

THE SATURDAY REVIEW *of* LITERATURE
25 *WEST* 45*th* *STREET, NEW YORK CITY*

NATURAL HISTORY

The Journal of the American Museum of Natural History

CONTENTS

VOLUME XXXV, No. 3 MARCH, 1935

A Tsimshian Chief of British Columbia . . . . *Cover*
From a Painting by W. Langdon Kihn

Indians of Southern Alaska . . . . *Frontispiece*

The Indians of the Northwest Coast . . . . Ronald L. Olson 183
Natives of the Beautiful Region Lying Between Puget Sound and Southern Alaska

Spring in the Garden . . . . Carol H. Woodward 198
Flowers That Bloom Soon After the Winter's Snows Have Melted

Submarine Power Plants . . . . Christopher W. Coates 209
Fish That Generate Electricity with Which to Shock Their Enemies and Overcome Their Prey

The Mountains of Glacier Park . . . . Carroll Lane Fenton 213
An Account of One of the Youngest Sections of the Rocky Mountains

The Story of Silk . . . . Donald D. Leonard 221
The Processes by which the Filament Spun by the Silkworm Becomes the "Queen of Fabrics"

The Elk of Jackson Hole . . . . Olaus J. Murie 237
The Problem That Has Arisen from the Increase in the Numbers of Animals on a Decreasing Range

The Dodo of Mauritius . . . . Dorothy L. Edwards 248
The Story of a Bird that Has Been Extinct for Two Hundred Years

Below the Border . . . . Alfred M. Bailey 250
A Naturalist's Visit to the Mountains near Durango, Mexico

George D. Pratt (1867–1935) . . . . Madison Grant 260
A Trustee of the American Museum

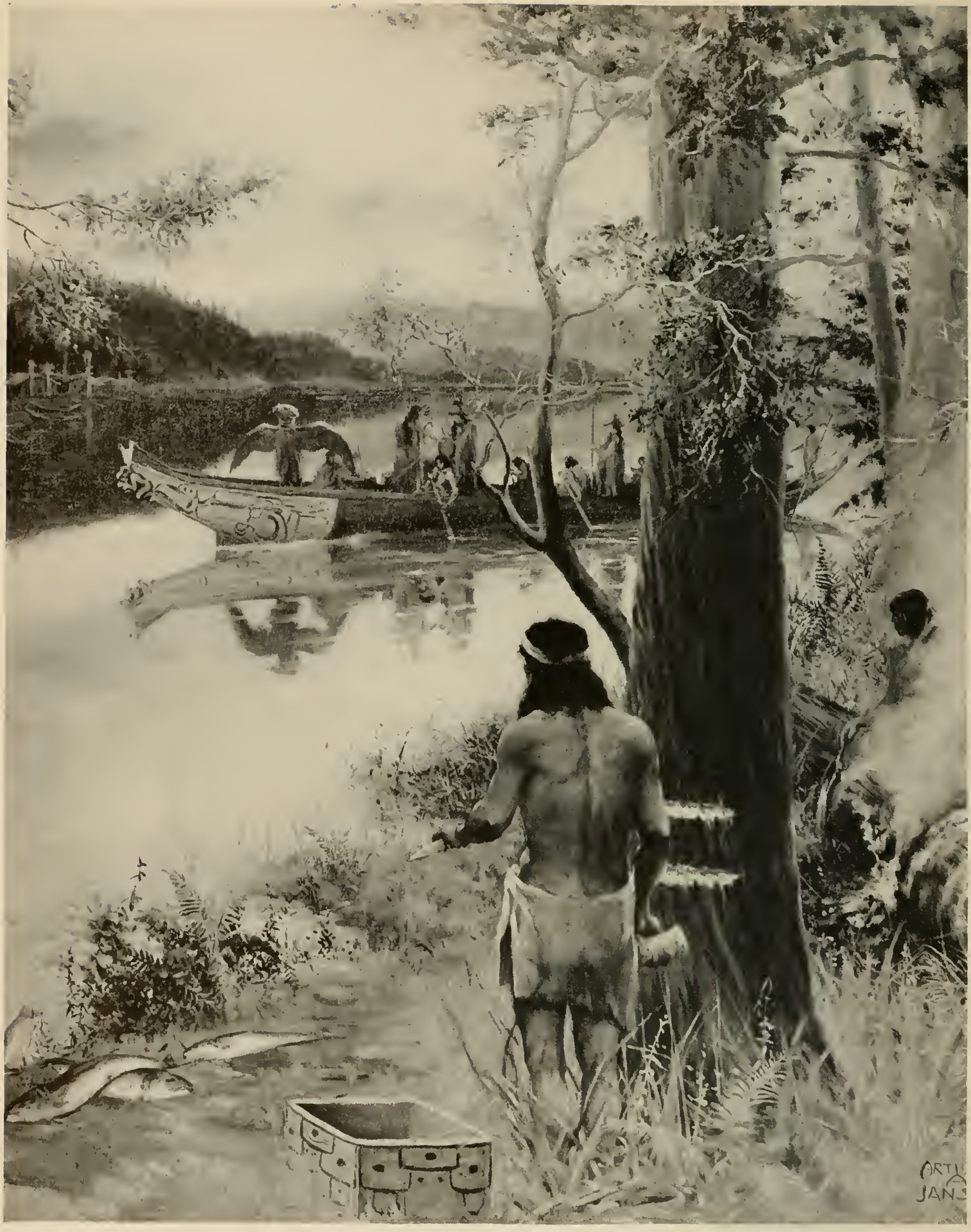
Science in the Field and in the Laboratory 262
Current Events in the World of Natural Sciences

Reviews of New Books 267
Recent Publications for Those Interested in Nature

HAWTHORNE DANIEL
Editor

A. KATHERINE BERGER
Associate Editor

NATURAL HISTORY—Publication Office, 10 Ferry Street, Concord, New Hampshire
Subscriptions should be addressed to 10 Ferry Street, Concord, N. H., or to The Treasurer, The American Museum of Natural History, 77th Street and Central Park West, New York, N. Y. NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership, $2.10 of the annual amount received from each membership being in payment of the year's subscription to the magazine. GEORGE L. ALPERS, Advertising Manager, Advertising Office, The American Museum of Natural History, 77th Street and Central Park West, New York, N. Y. Copyright, 1935, by The American Museum of Natural History, New York



Indians of Southern Alaska

A reproduction of a painting by Arthur A. Jansson portraying a composite of native activities against a typical natural background. The canoe is bringing in a group of ceremonial visitors, while ashore the ever-present fish are being prepared for food. At the extreme right a fire is being used to girdle a log

NATURAL
HISTORY
March, 1935

The Indians of the Northwest Coast

Inhabitants of a land rich in scenic beauty, the natives of the region lying between Puget Sound and southern Alaska have developed an art and a social organization unique among the peoples of the world

By Ronald L. Olson
Associate Professor of Anthropology,
University of California

ALONG the two-thousand-mile fringe of the Pacific coast lying between Humboldt Bay in northern California and Yakutat Bay in Alaska there flourished, until recent years, one of the most unique and colorful civilizations of aboriginal America. The cultures of most of the rest of North America have been enriched to a greater or lesser extent by the spread of arts and institutions from the high civilizations of Mexico, but the peoples of the North Pacific seem to have been too far removed from Middle America to profit culturally from that source. Between them and Mexico lay the culturally barren areas of California and the Great Basin — an effective barrier against cultural contacts from the south.

From Puget Sound northward the coastal belt is extremely mountainous. But subsidence and glacial action have combined to form long fjord-like inlets which reach back into the heart of the coastal ranges. Off the mainland coast lie thousands of islands, ranging in size from mere specks of rock to Vancouver Island (300 miles long) and the Queen Charlottes. On both mainland and the larger islands the mountain ranges rise abruptly from the shore to snow-capped masses of from 5000 to 10,000 feet. Innumerable streams pour their waters down the sides of these ranges, and here and there large rivers, such as the Fraser, Skeena, Nass, Stikine, and Taku, cut through the main coastal range of the mainland to the Pacific.

Although it lies in the high latitudes, this coastal fringe has a remarkably mild climate. The warm Japanese current flows northward until it strikes the Alaska coast, then swings eastward and southward along the coast, affecting the climate as far south as California in much the same way that the Gulf Stream tempers the climate of northern Europe. During the greater part of the year the winds are westerly. As they strike the mountainous coast, these warm, moisture-laden winds produce copious rains during the season from September to May. The rainfall varies from about 50 inches in the Puget Sound area to well above 200 on the northern coast of British Columbia. There are a few localities where rain falls on more than 300 days during the year. The tale is told of how one of the early missionaries made a confirmed pagan out of one of his new converts by relating to him the tale of the Deluge from the Bible. Told how 40 days and nights of rain caused a flood which covered the highest mountains, the chief gave vent to profound skepticism, adding, "I've seen it rain for 40 months, day and night, without it causing a flood!"

Mild year-round temperatures and abundant moisture combine to produce a tropical luxuriance of forest growth. Giant trees of cedar, fir, spruce, and hemlock cover mountain and valley from the ocean's edge to a

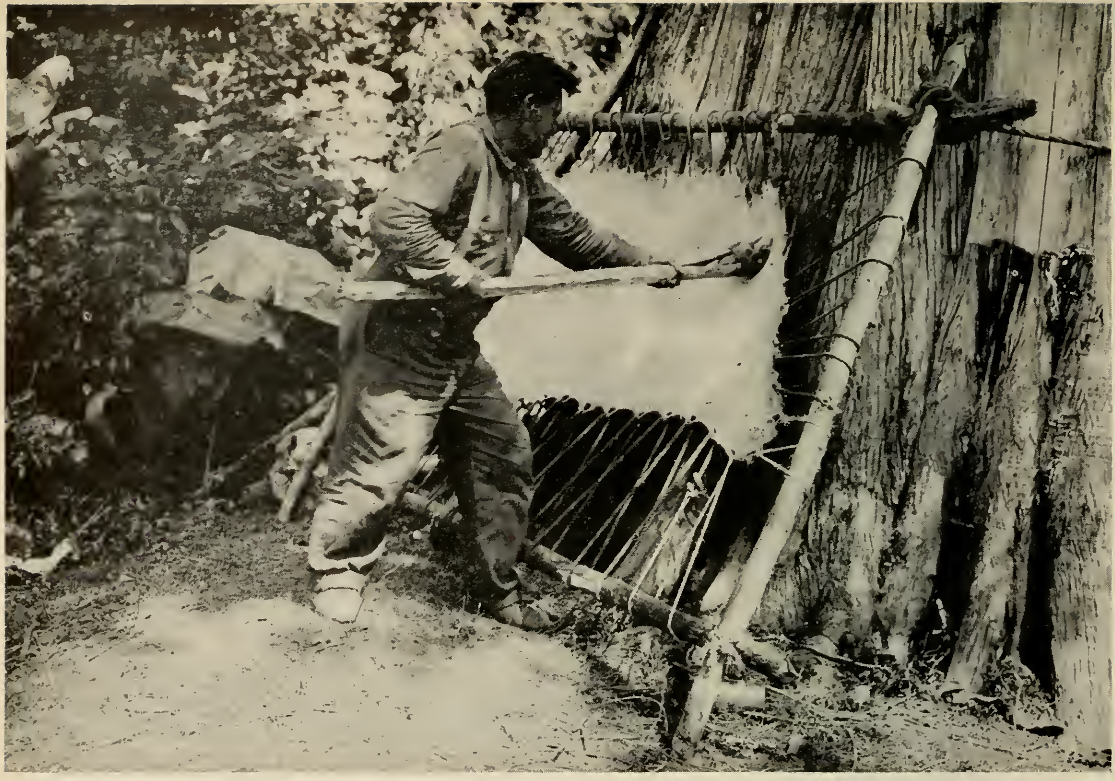


Photo by H. I. Smith

Courtesy, National Museum of Canada

(Above) Scraping a hide preparatory to tanning it

(Left) A Carrier Indian woman and her child. Her costume no longer includes even a remnant of the aboriginal, but the age-old practice of carrying a baby on her back still prevails

(Below) A Kwakiutl woman, Vancouver Island, preparing fish for storage

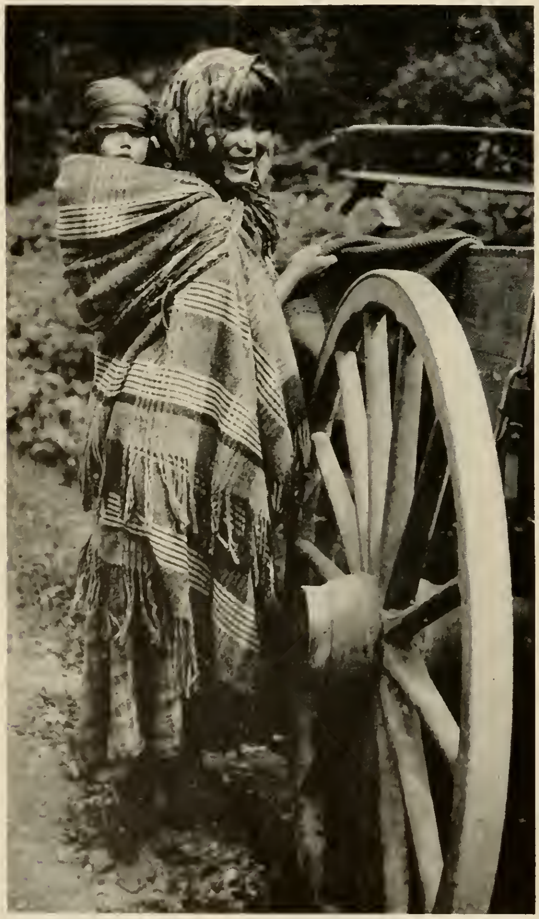


Photo by H. I. Smith

Courtesy, National Museum of Canada

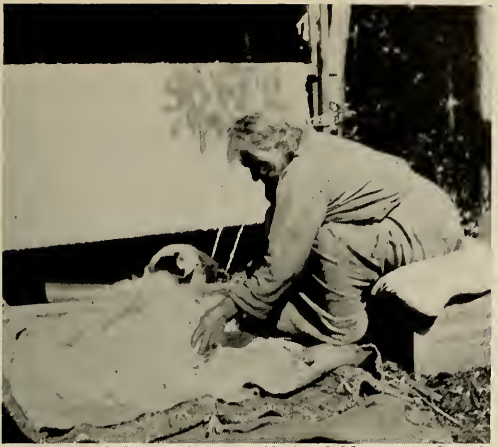


Photo by H. I. Smith Courtesy, National Museum of Canada

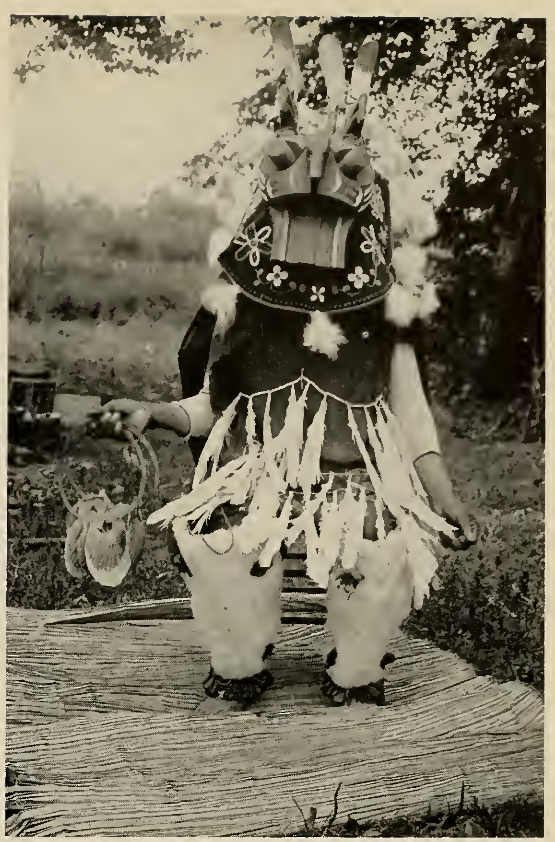


Photo by H. I. Smith Courtesy, National Museum of Canada

(Above) A Coast Salish woman weaving a blanket from the wool of the wild mountain goat

(Right) A masked dancer of Vancouver Island

(Below) A Carrier Indian family. The Carrier, an Interior, Athapascan-speaking people, are culturally largely influenced by the Coast tribes

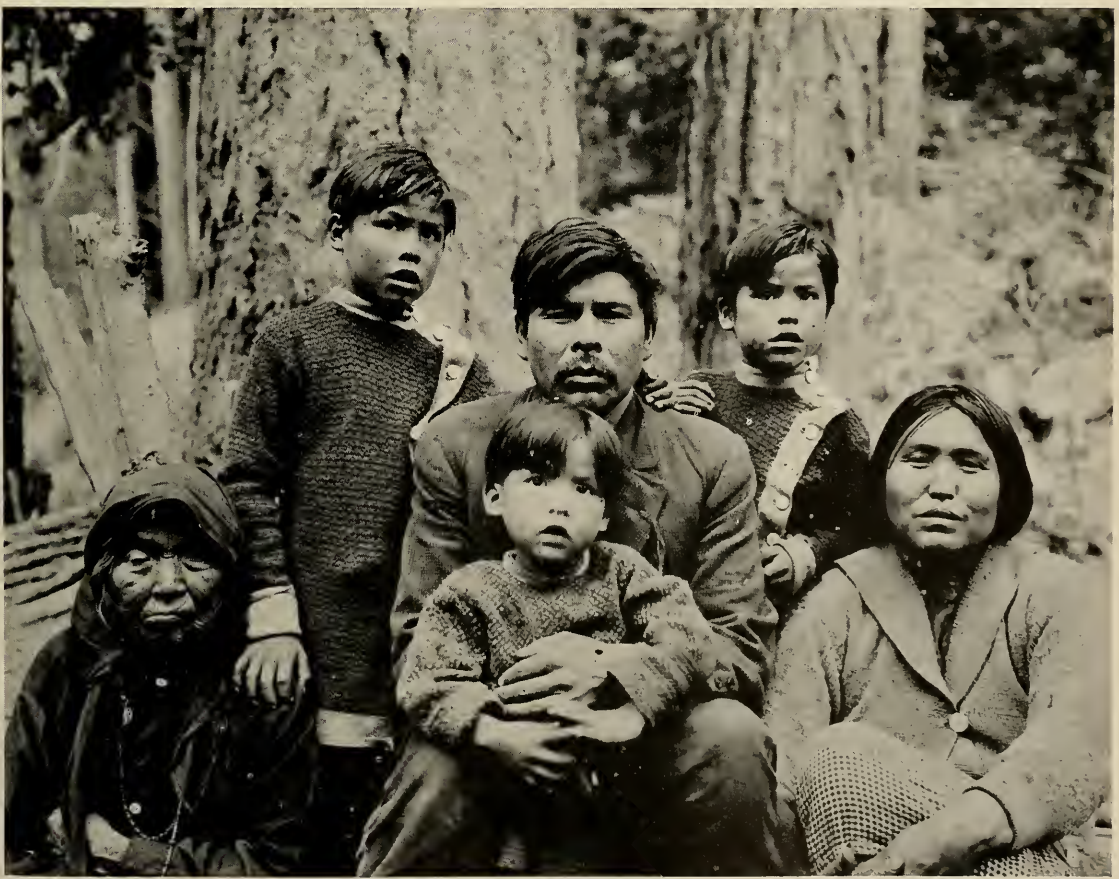


Photo by H. I. Smith Courtesy, National Museum of Canada height of about 4000 feet. The ground beneath them is thickly set with the bushes of berry and other shrubs and with a dense growth of mosses and giant ferns. This almost impenetrable forest and the rugged nature of the landscape make land travel almost impossible. Travel by water would also be difficult for the native inhabitants were it not for the groups of islands which flank the coast, forming the famous "Inside Passage" from Puget Sound to Alaska. But the narrow channels and passes of the inlets and among the islands provide ideally quiet waters for canoe travel.

THE FOOD SUPPLY

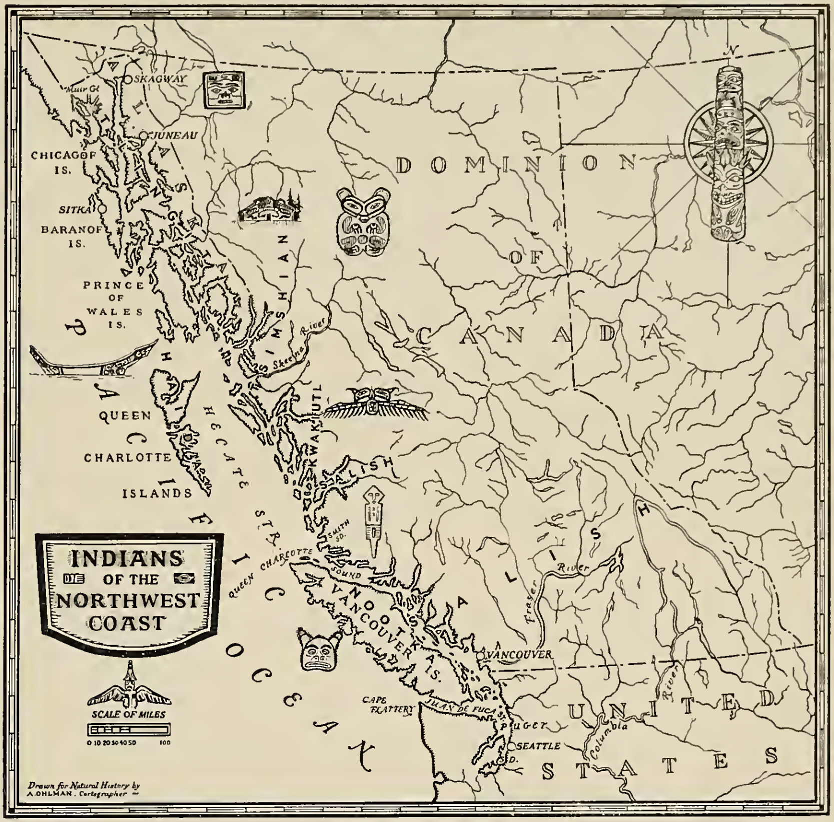
In the forests and mountains such game animals as deer, bear, and mountain goat are abundant, but the difficulties of land travel make hunting them a hard task. The peoples of the region look to sea and stream for the great bulk of their food supply. Agriculture, the prime source of food for the peoples of Middle America, was unknown, except for the raising of tobacco. But no region in the world boasts a greater abundance of sea life than does this. Tides which vary as much as twenty feet between high and low water expose beaches supporting an inexhaustible supply of edible mollusks. Cod, halibut, and other fish may be caught in the ocean depths. Herring, smelt, and the oil-yielding eulachon or candlefish swarm along the beaches or in the lower reaches of the rivers at certain seasons of the year. Salmon run in the streams and rivers in such numbers that they often literally fill the channels. Seal, porpoise, sea otter, sea lion, and various types of whale are abundant everywhere. The peoples of the area make use of all these, but the salmon is the staple food, the staff of life.

Nature was prodigal in her bestowal of riches and the struggle for existence is never severe. The natives are able to accumulate a sufficient supply of food during the few months of summer to provide an abundance for the remainder of the year. A small stream has been known to yield more than a million salmon in a single season. Perhaps this superabundance of food, allowing months of leisure time, was a factor in the building up of a culture striking in its material aspects and rich in its social and ceremonial features.

The area is occupied by tribes which are members of various linguistic stocks, but all are essentially alike in culture, and fundamentally alike in physical type. As a whole, they are similar to the general American Indian type with brown skins, broad faces, and straight black hair; but these coastal peoples resemble the Chinese-Japanese type more than do their kinsmen to the south and east. Possibly this difference is to be laid to the infiltration of Chinese and Japanese blood in fairly recent times. At any rate, the records of the past 150 years show that more than fifty Asiatic junks have been driven on the American shore during that time. Perhaps during the past 2000 years a sufficient number of Asiatics have reached the shore alive to affect the physical type of the natives of this part of America.

The region about Puget Sound is occupied by peoples of Salish speech. The Nootka occupy the west coast of Vancouver Island. On northwestern Vancouver Island and the adjacent mainland north to Douglas Channel are the Kwakiutl. The Haida live on the Queen Charlotte islands, the Tsimshian along the Nass and Skeena rivers, and the Tlingit in southeastern Alaska. In the main the culture of all these groups is similar, but in most respects that of the last four groups is superior to that of the peoples to the south.

Although they are hunters and gatherers of wild products, these peoples are not nomadic. During the summer months they go in small groups to various fishing and hunting sites, where they prepare the year's supply of food, chiefly dried salmon. But during the greater part of the year they live in huge rectangular plank houses grouped into villages. The framework of the houses consists of massive posts and beams carefully adzed and trimmed to uniform dimension. Over these are laid rafters and secondary beams. Walls and roof consist of planks split from cedar. An average house measures about 30 by 40 feet, but some are as much as 60 by 100 feet. The houses in a village usually extend in a row along the beach, facing the water. Each house is the


SKAGWAY
Muir Gl.
JUNEAU
CHICAGOF IS.
SITKA
BARANOF IS.
PRINCE OF WALES IS.
QUEEN CHARLOTTE ISLANDS
HECATE STR.
TSIMSHIAN
Skeena River
KWAKIUTL
SALISH
Smith Sd.
Queen Charlotte Sound
VANCOUVER IS.
VANCOUVER
CAPE FLATTERY
JUAN DE FUCA
PUGET SD.
SEATTLE
Fraser River
Columbia River
DOMINION OF CANADA
UNITED STATES
PACIFIC OCEAN
N.
INDIANS OF THE NORTHWEST COAST
SCALE OF MILES
0 10 20 30 40 50 100
Drawn for Natural History by A. OHLMAN, Cartographer

Geographical location of the Indian tribes of the Northwest Coast. Though culturally alike in most essentials, the tribes are linguistically differentiated. From north to south these are Tlingit (Koluschan); Haida; Tsimshian (Chimmesyan); Kwakiutl (Wakashan); Nootka (Wakashan); Bella Coola (Salishan); exclusive of numerous subgroups

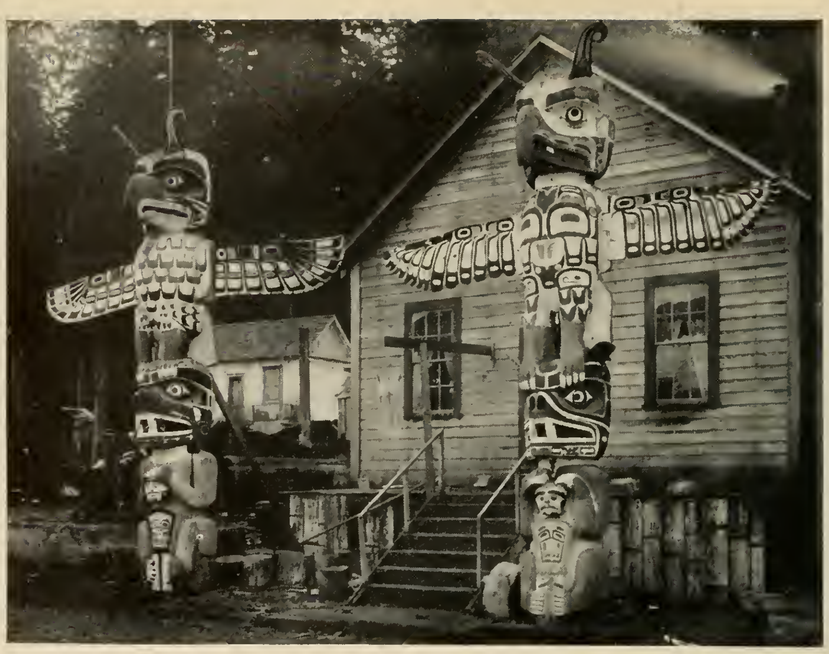
place of abode of several families, for the size and the expense of construction make it impractical for a small family to occupy an entire house.

The interior of the house rises in a series of terraces or benches from a sunken area at the center where there is a common fireplace. These benches serve as storage spaces and sleeping platforms. The furniture of the interior consists of painted screens, mats, blankets, carved and painted boxes, and so on. In front of nearly every house stands an elaborately carved "totem pole," the animal and human figures of which proclaim the lineage or clan of the owner.

As remarkable as the houses, are the canoes which these peoples build. From the giant cedars of the area "dug-out" canoes up to 70 feet in length, 8 in beam, are hollowed from a single log. Crafts more beautifully formed or more seaworthy are built nowhere else in the world. In these canoes war expeditions and trading voyages of several hundred miles were formerly made. In them the Nootka voyage on the open ocean of the boisterous coast of Vancouver Island and harpoon whales. Not the least remarkable feature of these crafts is that the trees were cut and the entire canoe built with nothing more than tools of wood, bone, and stone.

The art of pottery making is unknown in the area, but vessels and containers which serve as substitutes are baskets and boxes. Waterproof baskets are twined from spruce root fibers. Boxes are made by cutting kerfs in a board and bending it to form the sides. The open corner and the bottom are secured by driving in wooden pegs or by sewing with spruce roots. Bowls and platters are hollowed out of a block of wood, while ladles and spoons are shaped from wood or horn.

Nearly all these objects are carved or painted in the characteristic designs of the area, many of them referring to the crests, totemic animals, or the mythical ancestors of the owner. Nearly every object, whether utilitarian or ceremonial in purpose, is thus decorated. While highly conventionalized, the art style retains a certain quality of



Totem poles and houses at Alert Bay in British Columbia. These poles are now often set up in front of houses which have no relation or resemblance to the old type of architecture

In the Land of Totems

A house interior at Kitwanga, a Tsimshian village on the Skeena River, showing a conglomeration of ancient totem poles and modern tools and equipment

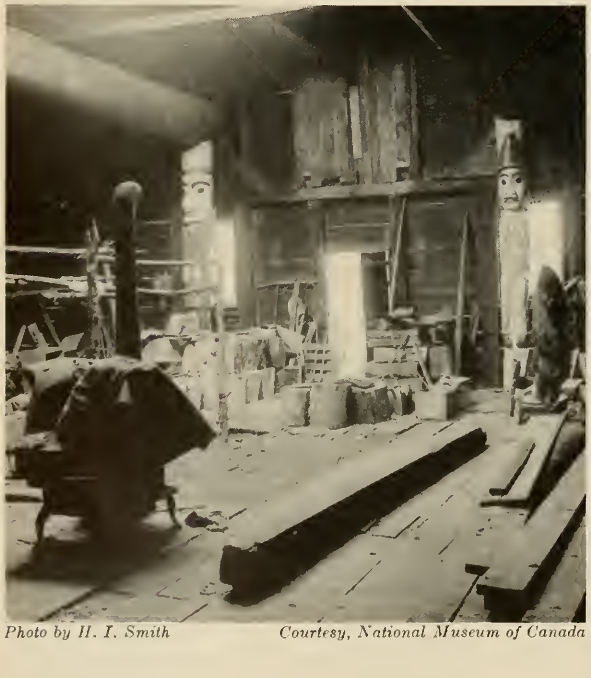


Photo by H. I. Smith *Courtesy, National Museum of Canada*

A Bella Coola fish-drying rack. Fish and shellfish were formerly food staples for all the tribes of the Northwest Coast. The fish are split and hung on poles to dry in the smoke of the fires built beneath

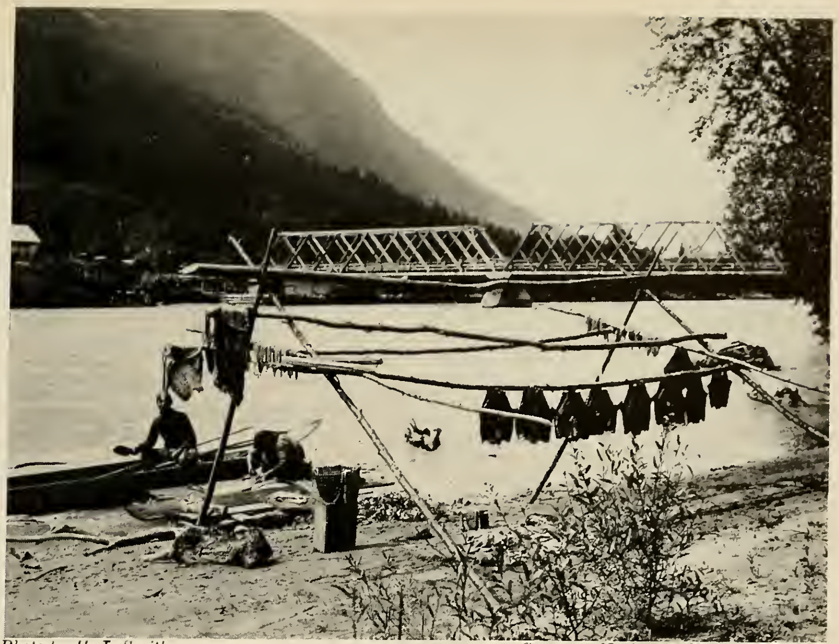
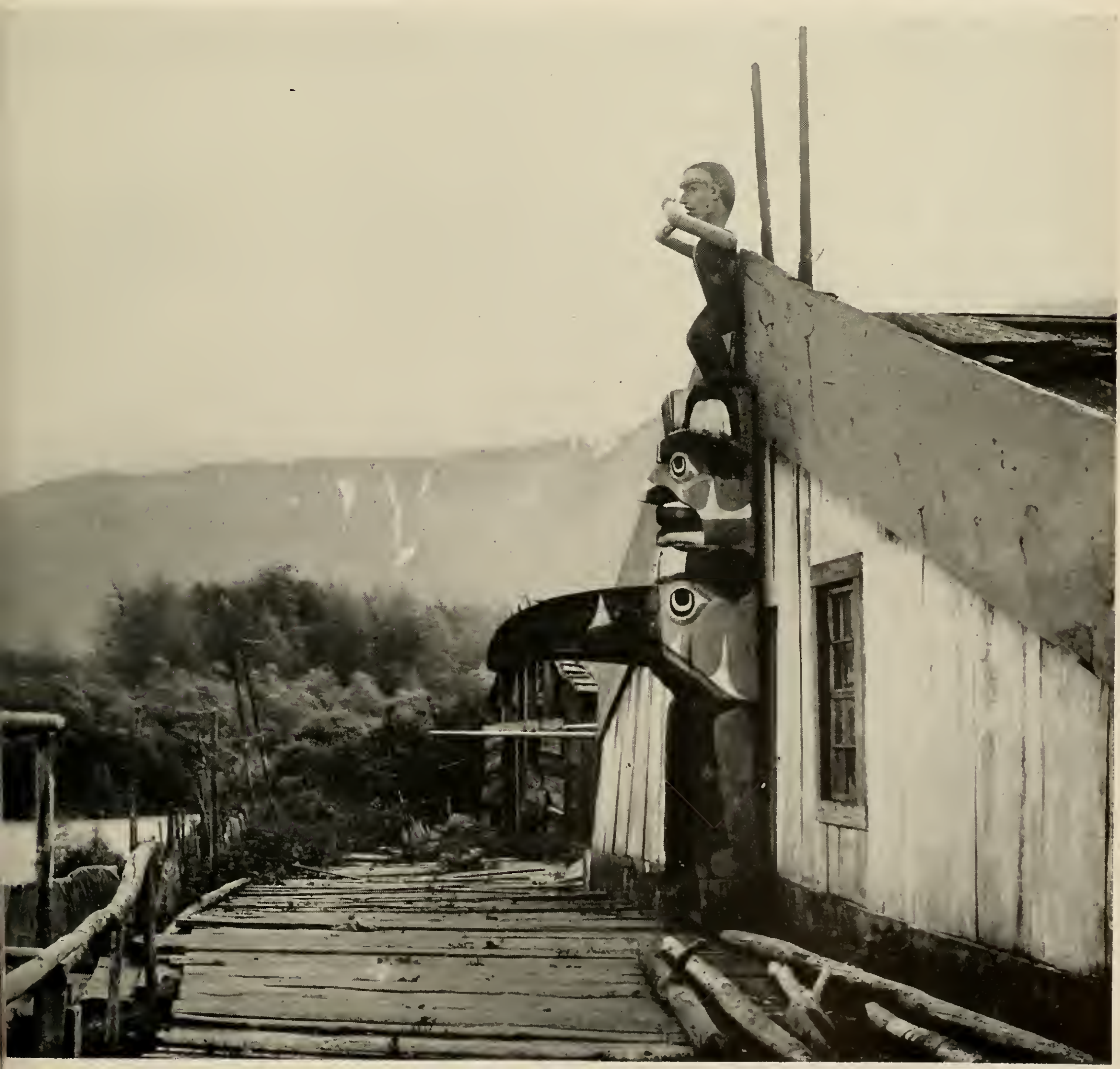


Photo by H. I. Smith

Courtesy, National Museum of Canada

A portion of the pagan division of a Bella Coola village. The lower section of the totem pole at the right is now in the American Museum collection



realism. Particular features of an animal, such as the teeth of the beaver, the dorsal fin of a killer whale, are emphasized. The figures are usually distorted to conform to the shape of the object decorated, but are recognizable because the features which conventionally identify them are always present. Similar designs were woven into blankets, painted or tattooed on the body, and carved or painted on canoes, paddles, house-posts, boxes, and so on.

In contrast with this skill in woodworking is the poverty of wearing apparel. Wholly absent is the tailored clothing of the Eskimo and other northern tribes. A blanket woven from cedar bark or other fiber, a basketry hat, and a fur cloak or blanket are almost the only articles of apparel. Both winter and summer men and women went about barefoot. The reason for this difference from the majority of North American tribes lies in the fact that dressed skins (buckskin) become soggy and of no use in wet weather, hence are seldom of service in a climate as rainy as this.

THE LACK OF POLITICAL ORGANIZATION

Despite the fact that the region is fairly densely populated, and that there are large, permanent communities, there is no political organization worthy of the name. There is no consciousness of tribal unity, no central tribal authority or unified government. Society is everywhere stratified into the nobility, the commoners, and the slaves. Within the ranks of the nobility there is an intense rivalry which prevents the delegation of authority. The core of every community is the group of nobles, each one the jealous guardian of his ceremonial privileges and prerogatives, which have been handed down to him through uncounted generations. Each prides himself on being the head of a household (a "house chief") or the head of a clan or lineage. The commoners are his "poor relations" occupying his house, often doing most of the labor, but sharing slightly in the dubious glory of being the relative of a great man. These castes are rigidly endogamous, that is, no noble would disgrace himself by marrying a commoner, and no commoner could hope to better his position by marrying a noble. The slaves are scarcely counted as human. For the most part they are war captives and the descendants of such captives. So great is the importance attached to caste that the taint of slave blood is remembered through many generations.

COMMONERS AND NOBLES

The commoners, though freemen, have few rights, little hope of bettering their position. The nobility have the wealth, the wealthy are the nobility. The nobles own or control the rights to fishing, hunting, and berrying grounds. They hold the "high names" which carry with them the right to particular seats in ceremonials, the right to give such ceremonials, the right to carve or paint certain heraldic devices as their crests upon various items of property. Even though a commoner succeeds in amassing some property, he can never hope to rise into the ranks of the nobility — that is a close corporation which is self-perpetuating.

Among the Tlingit, Haida, and Tsimshian, the caste system is complicated by the existence of maternal clans which are exogamous — that is, all clan-mates are counted as being close kin and so are forbidden to marry. Since a man takes his clanship from the mother's side, it follows that father and children always belong to different clans. These clans are further grouped into larger aggregates called moieties or "halves." Among the Haida these are known as Raven and Eagle, among the Tlingit as Raven and Wolf. No Raven may marry a Raven and no Wolf a Wolf. Membership in these is also through the female line. All personal names, all property, all ceremonial privileges and rights remain within the clan or moiety. It follows that, while men own and control nearly all property, they may not pass it on to their children — who are outside the father's clan.

This conflict of masculine ownership and female descent has resulted in some curious rules. At a man's death his property passes to his sister's son, who is regarded as next of kin within the same clan. When a lad is six or eight years old, he leaves the paternal roof and goes to live at the home of his maternal uncle, who rears him carefully, training him in the tribal customs and lore,

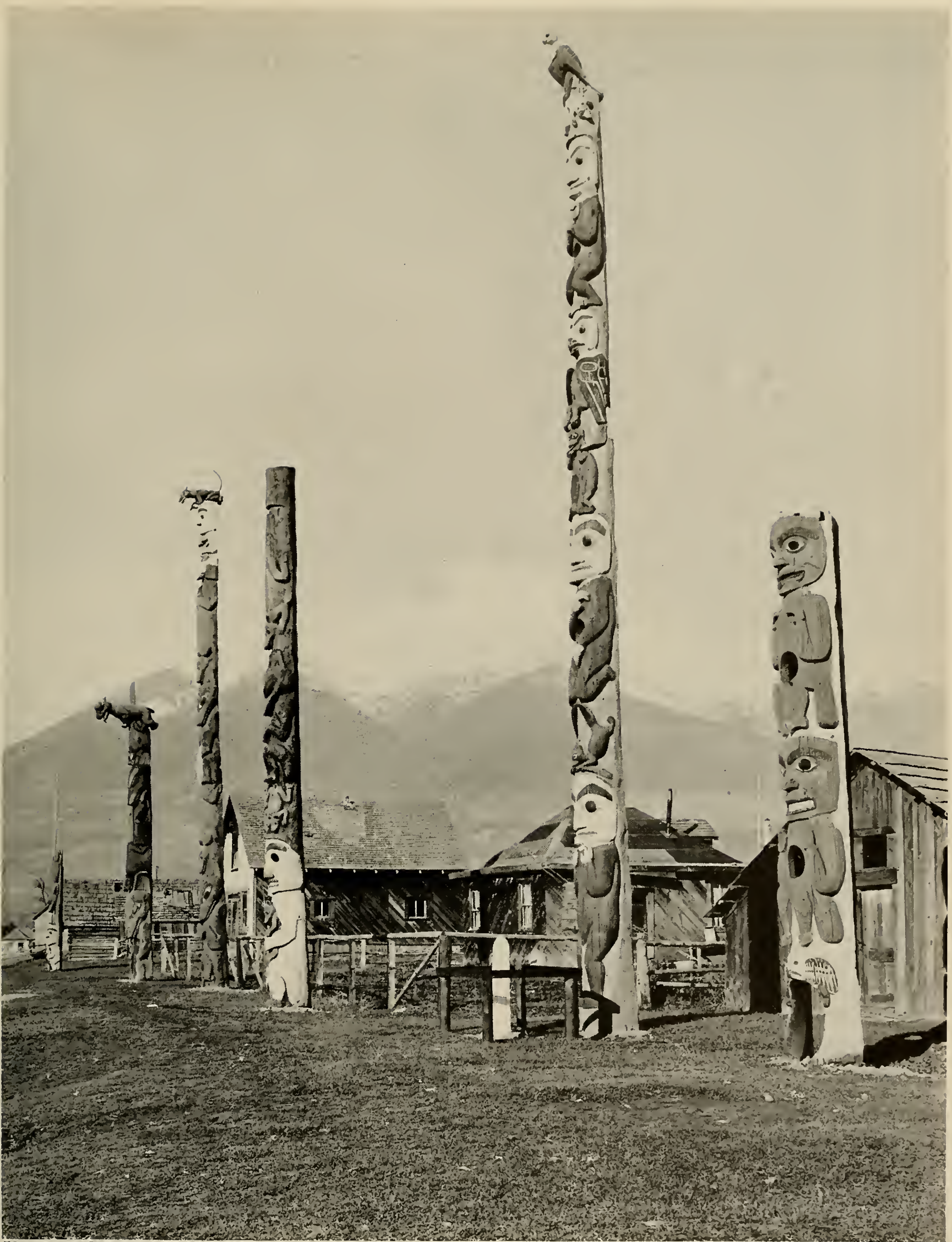
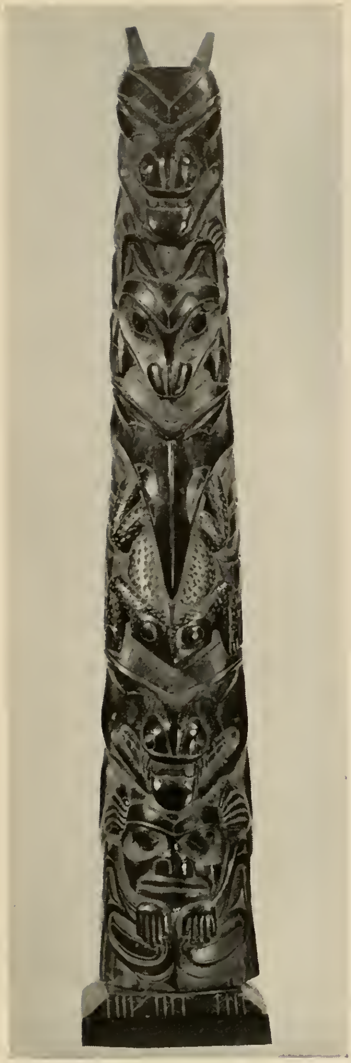
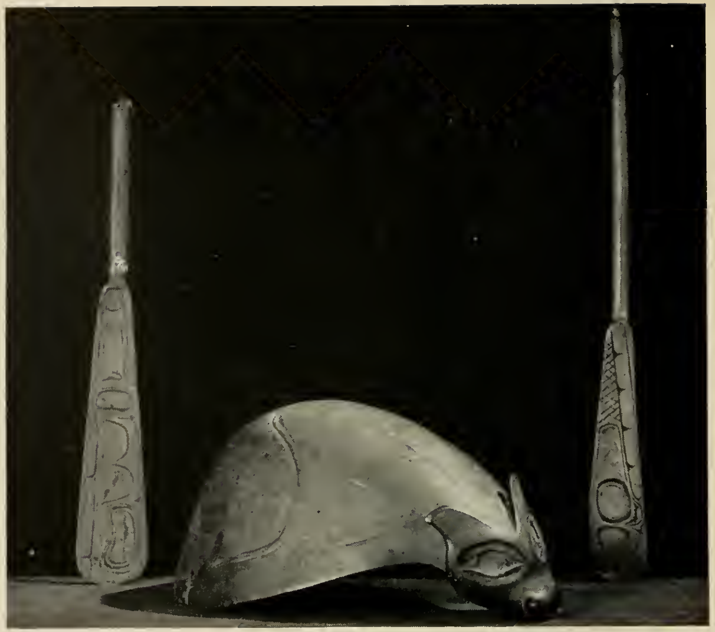


Photo by H. I. Smith *Courtesy, National Museum of Canada*

Totem Poles

A Tsimshian village at Kitwanga on the Skeena River. Though the houses are a far cry from the aboriginal types, each is still sentineled by its totem poles. These usually represent in the grotesque, conventionalized forms of the art of the area, the family crests. Frequently the traditional animal ancestors of the family are represented in distorted human form

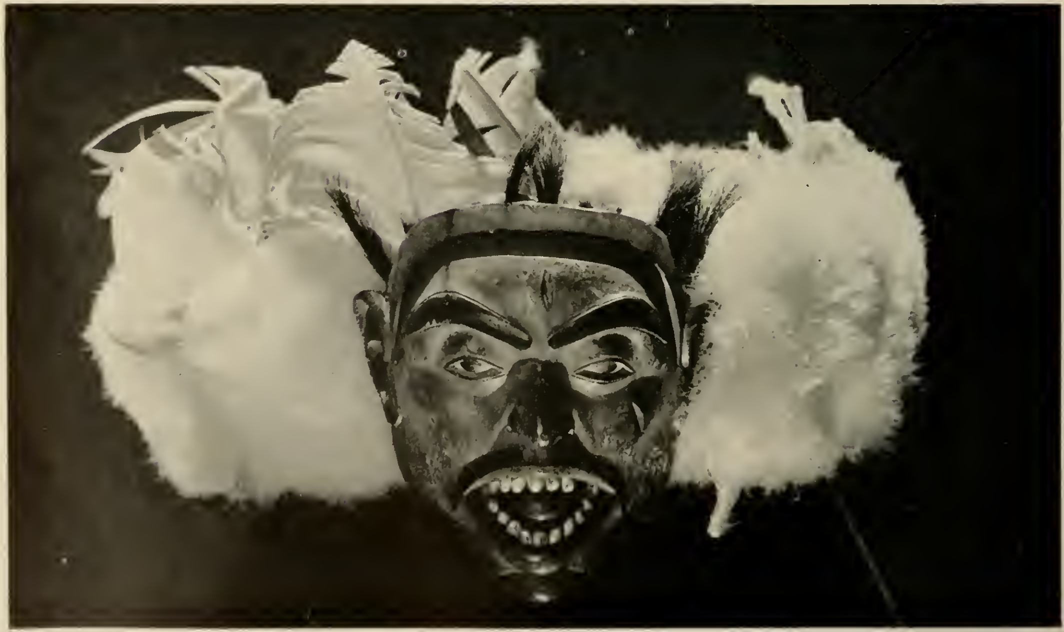




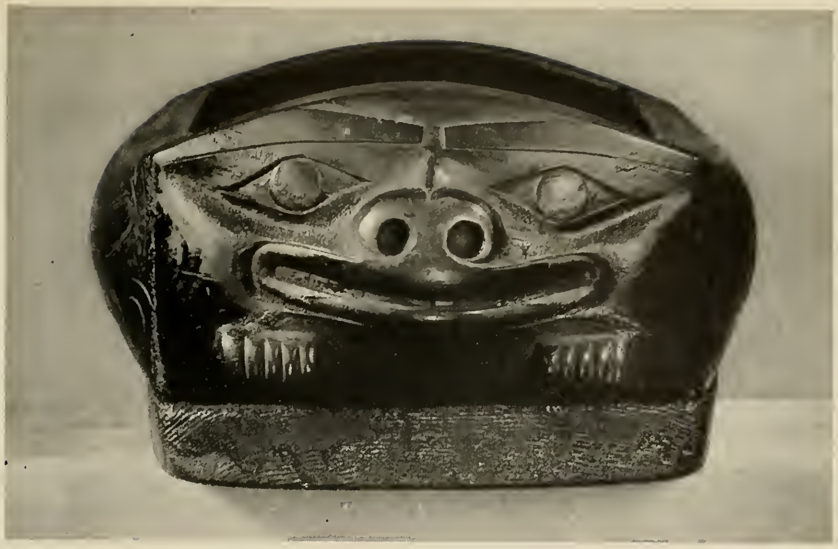
Highly conventionalized carving is found not only on ceremonial objects, but on the lowliest of household equipment, like the soapberry spatula-like spoons and ladle shown above

A relatively modern development among the Haida Indians is the elaborate carving of slate to be seen in small totem poles, boxes, and huge flat platters

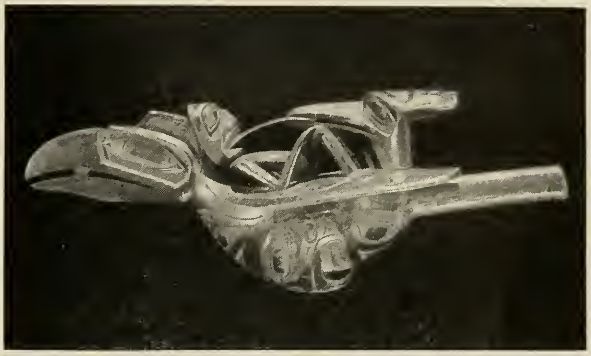
A headdress worn in the healing ceremony. The spruce framework is covered with swan's down and further decorated with perpendicular eagle tail feathers and human hair. The mask represents a dying man, with open mouth, protruding tongue, and gashes on forehead and cheek



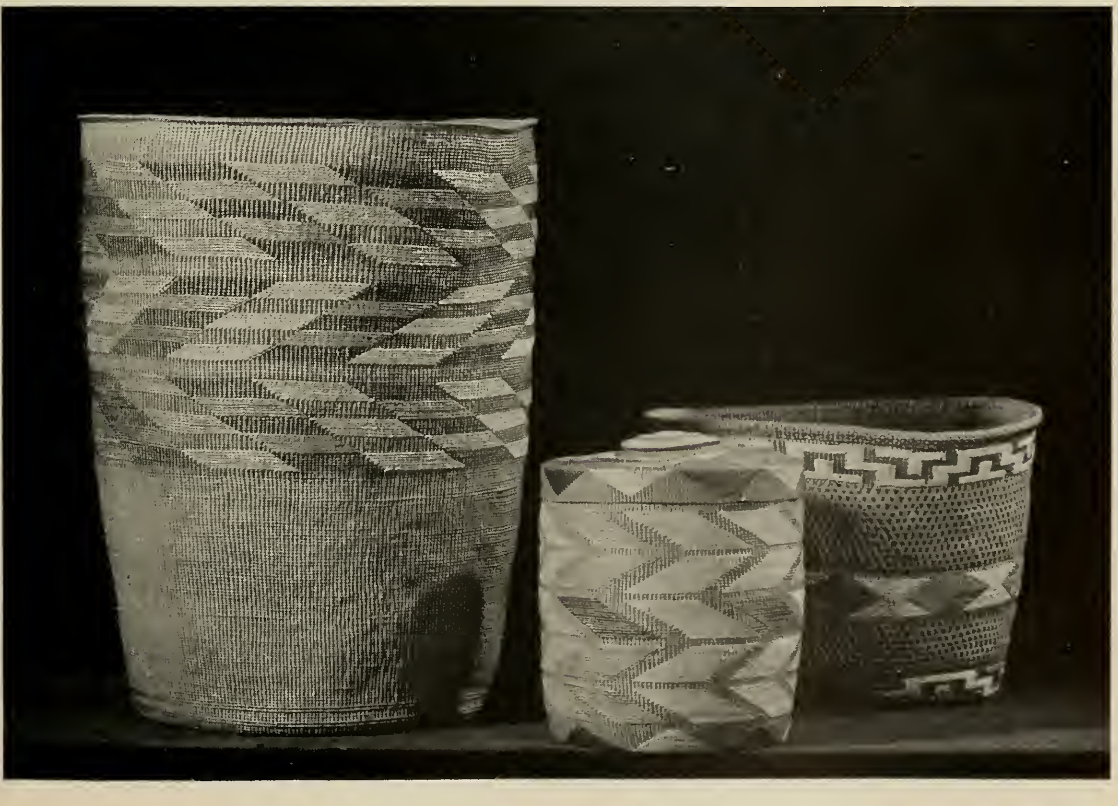
The high attainment of the Indians of the Northwest Coast in woodworking finds no better exemplification than in the carved food dishes



Rattles of this conventionalized pattern are usually attributed to the Raven clan. This Haida Indian carving represents a raven on the back of a hawk



Tlingit baskets. These colorful and finely twined baskets were woven by the women from split spruce roots and artificially colored grass. Innumerable domestic purposes are served by the baskets



treating him harshly if he fails to heed. At the death of the uncle, the nephew often marries the aged widow, assumes his uncle's name, takes title to his uncle's house and other property, and in every way assumes his uncle's position. These rules obviously run counter to the instinctive desire of the father to pass his property to his own children instead of to the children of another. But so strong are the bonds of clanship, and so rigorously guarded are the ceremonial rights of the clans, that paternal instincts bow down before the purely formal rules of clan membership. A partial solution of these conflicts is achieved through the common custom of marriage with the daughter of the maternal uncle, i.e., with a cousin, so that the property goes to the nephew-son-in-law. This cousin, being of a different clan, is not counted as a relative.

"JUSTICE," FEUDS AND WARFARE

Nothing bulks so large in the lives of these peoples as clanship. Clan bonds, clan loyalties, and clan pride transcend all else. If a man is murdered, a blood feud is initiated between the two clans (it being unthinkable that anyone would kill a clanmate). Unless cool heads persuade a settlement by compensation, the feud proceeds on the basis of a life for a life. No attempt is made to kill the murderer, however, unless he be of a rank (or "value") equal to that of the murdered man. Instead, the injured clan names a person of equivalent rank, and the person so named is obligated to dress in his ceremonial robes and come out from his house to be shot from ambush by the murdered man's clansmen. To refuse would bring a disgrace upon the clan which would remain unforgotten for generations. Such a feud between clans obviously divides every family against itself and wives have been known to kill husbands, or children their father, out of clan loyalty.

Warfare (aside from blood feuds) was likewise conducted on the basis of clan against clan, Eagle clans being usually aligned against Wolf clans, seldom Eagle clan against Eagle clan.

Although the clans and moieties are always potential enemies, there are certain social conventions and obligations which are operative between them. Among the Tlingit no man may build his own house, erect a memorial column to a dead clansman, or even conduct the burial rites for a clansman. A man of the Raven "side" must hire these things done and they must be done by the Eagles. For every such task performed the Eagles must be feasted and paid goods for their services in addition. A man of the Eagle side may not even invite the Eagles to a feast. If he gives a feast the guests must be Ravens. In a way this ceremonial reciprocity and friendship are compensating factors which tend to soften the harshness of the tremendous sense of loyalty for that wholly formal, artificial group, the clan.

No people in the world are more wealth-conscious than these inhabitants of Northwest America, in fact they have been called "the capitalists of the North." But their concepts of wealth differ radically from ours, with our hoarding of securities, of "shares" in production goods. Theirs involves the accumulation of goods, it is true, but in the form of consumption goods for the most part — of foodstuffs, blankets, and so on. And their wealth is hoarded not for its own sake but in order that the owner may give it away in a grand ceremonial splurge known as the "potlatch" — literally a "giving away" feast. Every occasion or event of importance demands the giving of one of these ceremonial feasts by some noble of the clan, village, or household. His is the privilege and the obligation of representing his social group, of acting as host-agent for his poor relations. No one is born, no one reaches puberty, no one is married, no one dies, but some clansman must give the required feast to maintain his own honor and the prestige of his clan. No one may build a house or rear a memorial column without giving a costly feast.

Preparations for such a feast often involve years of planning, saving, and the making of arrangements with clansmen for loans. For it is but seldom that a single individual has sufficient means to bear the expense by himself. Tremendous quantities of foodstuffs must be collected for the feasting. Immense numbers of gifts, such as blankets, canoes, slaves, and so on must be

Courtesy, Canadian National Railways

Skeena River,
British Columbia

Living on the Skeena and Nass rivers are the Tsimshian Indians, whose villages formerly extended for some distance inland along these streams. Though living in an environment differing somewhat from that of the coastal and island peoples, culturally the differences were small. The Tsimshian carried on a brisk trade with the coastal tribes, securing from them food and other products of the sea not available to them in their own habitat

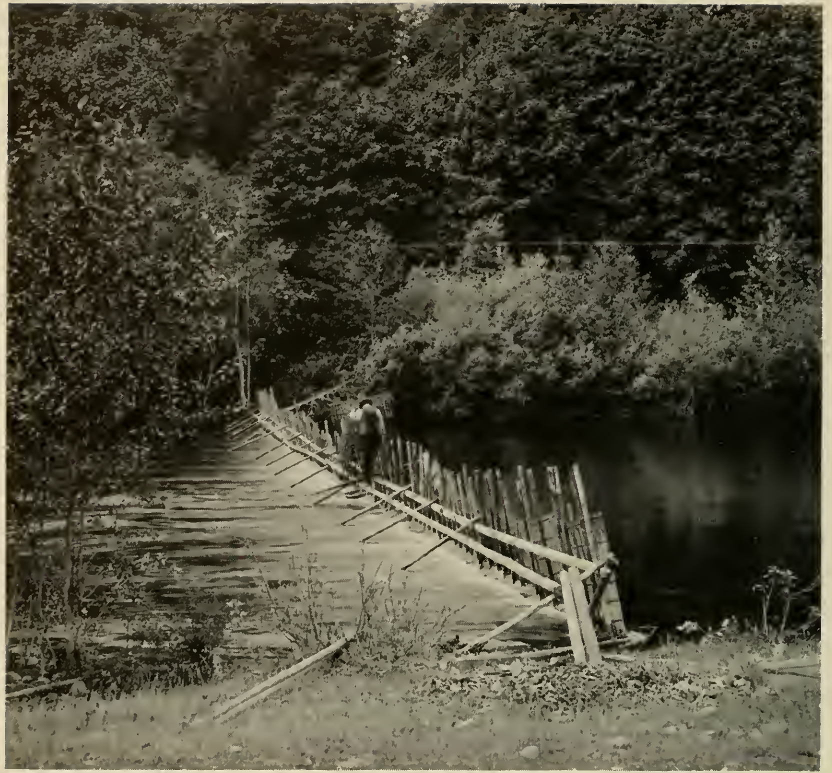


Photo by H. I. Smith

Courtesy, National Museum of Canada

At the left is shown a fish weir near Duncan, Vancouver Island, and below is a trap on the Bulkley River, British Columbia. Formerly salmon were most commonly taken in weirs built across or at the sides of streams. These varied considerably in form, as they were adapted to local conditions. Fish were also taken by spearing, by trolling, with nets stretched between canoes, and with hook and line

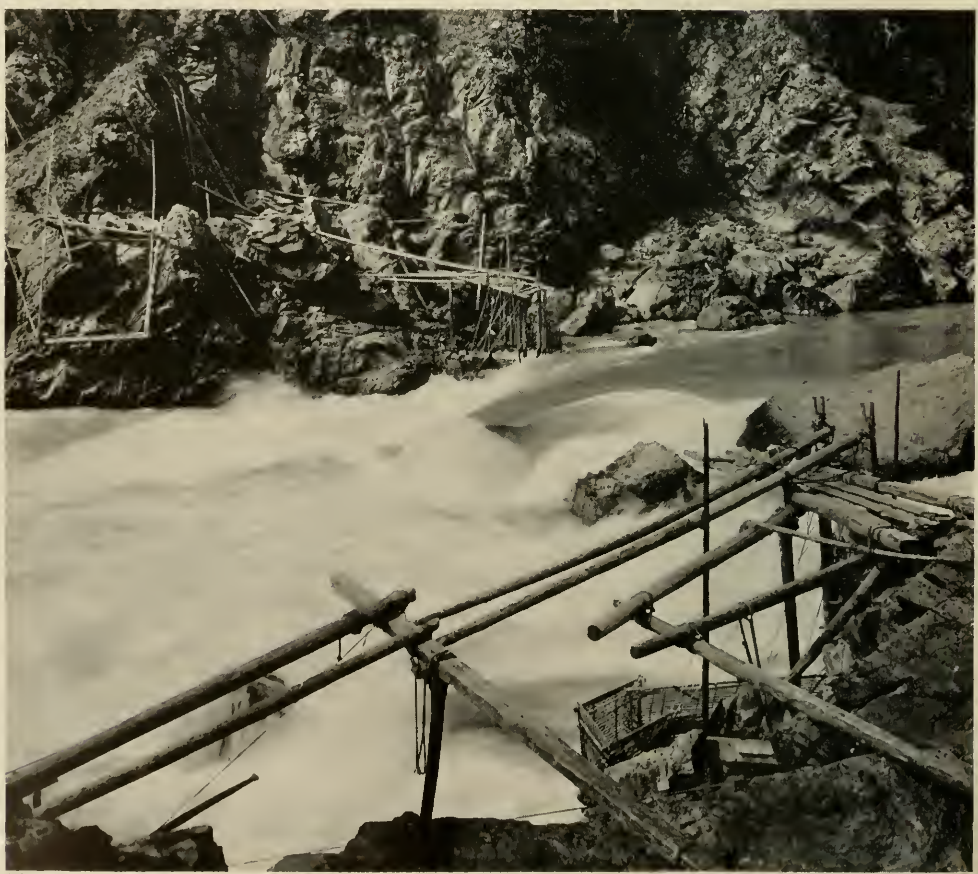


Photo by H. I. Smith

Courtesy, National Museum of Canada

on hand to pass out as presents. Usually the prospective host calls on all his clansmen in the home village to aid him. Since the giving of such a festival reflects glory on the entire clan no one can refuse help at such a time. Some time before the actual feast is to begin invitations are sent to the several clans or villages who are to be the guests.

THE CEREMONY OF THE POTLATCH

The entire ceremony, from the moment of the arrival of the guests, through the several days of feasting, is hedged about with an almost incredible amount of ceremony and formality. The seating arrangements are as carefully planned as at a diplomatic banquet. The place in the house where a given guest is to be seated depends wholly upon his rank in society, and this in turn upon the rank of his forbears. He inherits the right and privilege to a seat at a designated spot, or rather to a seat which has a particular name. In the giving of food the man of highest rank must always receive first, then the man of next highest rank, and so on. Throughout, there are elaborate formalities and speeches couched in ritualistic language.

After several days of feasting comes the time of the actual giving of gifts. Sometimes these gifts amount to tens of thousands of dollars' value in our currency, but are in the form of trade blankets, canoes, slaves, ceremonial objects of copper, and other objects of value. As in the case of the feasting, the guests of high rank receive first and receive the lion's share of the values involved. Commoners receive later and get only things of nominal value. At the end of the distribution of gifts the guests return home, and the impoverished host and his clan await the certain invitation to a similar return feast, at which they will be the recipients.

Wealth has served its end. Though well-nigh bankrupt, the host has created respect for his name and has glorified the name of his clan. His children will be grateful to him as well, for, although they are not of his clan, the fact that a father once gave a great potlatch will be remembered in the stories which go the rounds of the years. As Murdock has phrased it, "Amongst ourselves a man and woman may save and sacrifice to send their children to college; [Northwest Coast] parents give a potlatch. Only the method is different; the motive is the same."

Among some of the tribes intense rivalry centers around the giving of potlatches. Each chief tries to outdo the other. No proffered gift may be refused, yet its acceptance obliges the recipient to return an equivalent amount within a year — plus 100 per cent interest! Obviously such a give and take cannot continue for long, for no people in the world can double the "national wealth" each year for an indefinite period. In some cases these rivalries involve the actual destruction of property. Behind all the types of potlatch lies the concept that a man of wealth must show his contempt for wealth by giving it away, as if he had so much that its giving away made no difference. What better way of showing contempt for wealth than by destroying it? On occasion, slaves have been killed, valuable "coppers" thrown into the ocean, and great ocean canoes smashed to bits by the host in order to humiliate a rival. But this represents an extreme form of the potlatch, one out of harmony with the more common type found in this area.

* * *

In this brief sketch I have tried to outline some of the salient features of this unique culture which differs so markedly from others of Native America. A region of tremendous wealth of food supplies enabled the inhabitants to achieve a certain amount of leisure. Probably out of this grew the system of rank and caste based upon lineage and wealth. Out of this developed an exploitation of the natural resources which allowed the accumulation of vast amounts of goods. The sense of values revolved not only around rank and wealth, but developed along æsthetic lines as well, as is witnessed by a remarkable art style. The societies of the region are acquisitive in about the same sense as is ours. But the values, the motives are somewhat different. We accumulate wealth for the sake of the income it produces, with prestige a secondary factor. With them, prestige is all important and prestige cannot be achieved by mere hoarding.

Spring in the Garden

Even before the trees come into leaf many of the most beautiful of garden flowers are bright with blooms

By Carol H. Woodward
New York Botanical Garden

Photographs supplied by courtesy of the N. Y. Botanical Garden

WHETHER one's garden consists of a simple border of flowers or a vast estate comprising many types of plantings, the first crocus that opens its chalice with the passing of the winter's snows is a thrilling signal to gardeners of every station that spring is making its bow to the impatient world.

It is still too early to do garden work outdoors, except to complete those important tasks of digging and double-digging, fertilizing, and otherwise improving the soil — all tasks which should have been done in the fall, but which can be handled, if previously neglected, as soon as the ground becomes workable in the spring. There is also time for a last application of dormant sprays to the shrubs and trees that need protection from insect enemies — time, that is, if the leaves are still tightly wrapped in their winter coats, for dormant sprays, being extra strong, will promptly kill any young leaves or open buds they touch.

March is a good month, however, to start indoor work for the outdoor garden, but even for this a warning must be issued not to be over-zealous in sowing seeds. Only a few subjects — *Begonia semperflorens*, verbena, petunia, snapdragon, Iceland poppies, and some asters and zinnias for early bloom, for instance — can with wisdom be started the first of March. Most of the annuals (except those whose seeds are best sown in the bed where the plants are to bloom) and many perennials for next year's flowering grow most successfully if seeds are started indoors the middle of March.

While the home gardener is busy inside — mixing and sifting soil, scrubbing clay pots and filling them, leveling the surface, watering, and scattering new seed across the top, then sifting on the last fine soil before putting the pots aside, covered carefully with panes of glass and sheets of newspaper — the spring panorama is rapidly progressing outside his door. Except for such early shrubs as forsythia and jasmine, and some trees like the maples, which shake out their gay, scarlet tassels before the leaves appear, the crocuses, snowdrops, squills, and glories-of-the-snow, which have been set in the ground the previous fall, come into bloom in a world that is cheered chiefly by their bright flowers and leaves.

Snowdrops (*Galanthus*) really precede the crocuses in early spring, blooming frequently while snow is still on the ground. Because of this, their nodding, graceful, white flowers are scarcely a harbinger, but rather merely a hint of the coming spring. It is not till we see the crocuses, with their deep cups of lavender, yellow, and white, that we are convinced that the season of flowers approaches.

If we have not already cautiously lifted the winter covering from the borders, we will find, with the opening of the earliest crocus, many determined looking spears of green pushing their way toward the light, each cluster enfolding fat buds of squills and glories-of-the-snow. Within a few days their loose spikes of waxy white and vivid blue will be rivaling the early crocuses for recognition. The gardener with a sense of color combinations learns the exact tone of each variety of *Scilla* (squills) and *Chionodoxa* (glories-of-the-snow), and keeps discordant blues among these two flowers well separated by clumps of white and by the occasional pink that is sometimes found in both groups.

Incidentally, the gardener who wonders whether it really is *Scilla* or *Chionodoxa* that is coming up (the two look so much alike to the unpracticed eye), may be comforted by the fact that botanically they are so closely related that the two genera may be hybridized, producing what has been called a

Late

Spring

The increasingly warmer days and abundance of green on the shrubbery entices one into the garden retreat to enjoy Darwin tulips, with lilacs blooming overhead

Daffodils

Broad drifts of these gleaming golden and white flowers will blossom year after year when naturalized as though growing wild. Below are some of the types most frequently seen in gardens. At the left, "Thalia," one of the most graceful of the smaller trumpet daffodils; left center, "Epic," pure white with an orange border to its yellow crown, one of the Poet's Narcissi; right center, "Elizabeth Ryan" whose yellow crown is edged with white, one of the Barrii hybrids; right, narcissus "Her Grace," a large, pale-yellow trumpet

Chionoscilla. The most noticeable difference between these two flowers is that Chionodoxas have a short tube to the corolla, whereas among Scillas each perianth-segment (or "petal") is distinctly separated from the others, usually to the very base.

THE ROCK GARDEN

Quite different are the compact blue spikes of grape hyacinths, of which every gardener knows and loves that most commonly grown species, *Muscari botryoides.* About the time some of the miniature daffodils appear — the hoop-petticoat, *Narcissus Bulbocodium,* for instance, — grape hyacinths may be found standing among them like uniformed cadets in a ballroom filled with gold-skirted ballet girls.

Turning to the rock garden on a sunny day in March, we find the broad cups of the green hellebore already nearly spent. Then suddenly we discover how early the bees appear in the spring, for, when bending over to catch a whiff of fragrance from the first flowers of the rock-cress, we find that the bees are already enjoying their sweetness. The double-flowered rock-cress, which persists in bloom into the early summer, makes a handsome plant, but is seldom as fragrant as the single, early-flowering form.

Named *Arabis,* because it presumably came from Arabia, the rock-cress is not to be confused with another member of the Cruciferae, or Mustard family, one species of which adorns many a spring garden. This is the evergreen type of the common candytuft, *Iberis,* named from Iberia — ancient Spain — where many species grow wild. The common name of candytuft, by the way, refers to the island of Candia, or Crete, from where the first species was introduced into cultivation.

The fleeting patches of brilliant yellow that one sees in the springtime garden are the flowers of another indispensable crucifer, *Alyssum saxatile,* variously known as golden-tuft, basket-of-gold, or golden alyssum. The gray leaves of this, like the dark leathery green of the evergreen candytuft, *Iberis sempervirens,* adorn the garden throughout the summer and fall.

An unexpectedly sturdy-looking flower for this early in the year is the leather-leaf saxifrage, *Saxifraga* (or *Bergenia*) *crassifolia.* Its large, deep pink blossoms and broad, leathery leaves make a striking spot of form and color in rock garden or border. Set near the top of a slope in a rock garden, this plant is useful in keeping the soil from washing down the hill.

The brightest blue among the flowers of the spring is that enchanting species of Anchusa which so closely resembles a glorified forget-me-not that it has been named *Anchusa myosotidiflora.* Fortunately for the true forget-me-nots (*Myosotis*), if they do appear before their garish rival has ceased blooming, their choice of a moist, rich, partly shaded spot keeps them well separated from the sturdy sun-loving Anchusas.

But we are getting ahead of our story, for while we have been inspecting the borders and rock gardens, acres of daffodils have come into bloom. Many of these, it is true, are found among the other flowers, but they are most delightful when a broad stretch of land can be strewn with the bulbs, which will come up year after year in ever-increasing numbers, requiring virtually no attention further than letting their leaves ripen until about July. In the garden, after the flowers are gone, the leaves can be pinned inconspicuously to the ground with a forked stick or bent wire. In the open field or on a hillside, the easiest plan is simply to forego cutting the grass until a slight yellowing of the narcissus leaves indicates they have finished their work of manufacturing food which has been carried down to the bulbs in order to nourish the next year's growth.

THE FIRST DAFFODILS

The first of all daffodils to come into flower is the tiny variety *minimus,* one of the true trumpet daffodils (*Narcissus Pseudo-Narcissus*), of which there are countless fine horticultural varieties. Many of the large-flowered trumpet types bloom while the trees are still bare of leaves. One often goes out to enjoy the early daffodils during an April snowstorm.

Comfortable days, however, soon come to stay, and with them come many more

Snowdrops and crocuses are first to herald the spring, the nodding, waxen white flowers like those at the left often blooming while snow is still on the ground, while the crocuses open long before the grass turns green

(Below) Rock-cress spreads its fragrance and attracts bees early to the alpine garden

(Above) Basket-of-gold alyssum combines with Poet's Narcissus for a pleasant border effect. (Below) Japanese cherries bring an unfailing snowfall of flowers in May

(Above) Naturalized buttercups carpet the ground beside the woodland pool. (Below) Green hellebore blooms and is gone from the garden before the spring sunshine has aroused the other plants

(Above) Evergreen candytuft is a blithe flower for springtime bloom, and its leaves ornament the garden throughout the year

varieties of *Narcissus* — especially the types with crowns of medium length — *incomparabilis* and its varieties, with flowers three and four inches in diameter; the many *Barrii* hybrids, with smaller flowers and shorter crowns, originally all sulphur yellow, but varying through extensive breeding even to an occasional border of red; also some of the choice and increasingly popular milk-white *Leedsii* hybrids.

A few of the trumpet daffodil hybrids blossom quite late in the season. The true jonquil (*Narcissus Jonquilla*), which bears comparatively slight relation to the "jonquils" — the trumpet daffodils — of florists' windows, spreads its bloom over a large portion of the spring season. This is a small, graceful, highly fragrant flower of rich deep yellow, with hollow, rush-like leaves of glossy dark green. Admirably hardy in the region of New York, neither it nor its name is sufficiently well known in gardens.

With the exception of some of the late hybrids of large- and medium-crowned types, the last of all the Narcissi to bloom are the Polyanthus (*N. Tazetta*) and the Poet's Narcissus, or Pheasant's Eye (*N. poeticus*). Especially of *N. Tazetta* are there more hybrids than could ever be counted, some of which, like the Paper-White, are too tender to grow outdoors. Others, however, are perfectly hardy, and, with their broad leaves and clustered fragrant flowers, some pure white, some all yellow, and others yellow and white, they make pleasant additions to the springtime garden.

THE LATE SPRING GARDEN

The Poet's Narcissus, well known for its widely expanded white flowers with small, red-ruffled crown, is another delight of the late spring garden. *Narcissus poetaz* is a fairly recent hybrid which combines the clustered flowers of the Polyanthus type with the size and general appearance of the Poet's Narcissus, adding to these good qualities a pleasant fragrance and a graceful manner of growth. These, however, are generally used for forcing in the greenhouse, not being quite hardy enough to raise outdoors in northern states.

Before the late-blooming daffodils are gone, the dwarf iris come into bloom in many colors — yellow, white, all shades of purple, blue, and many tones of brown. Rugged little plants are these, presaging a long season of magnificent bloom from their bigger brothers, the medium and tall bearded iris.

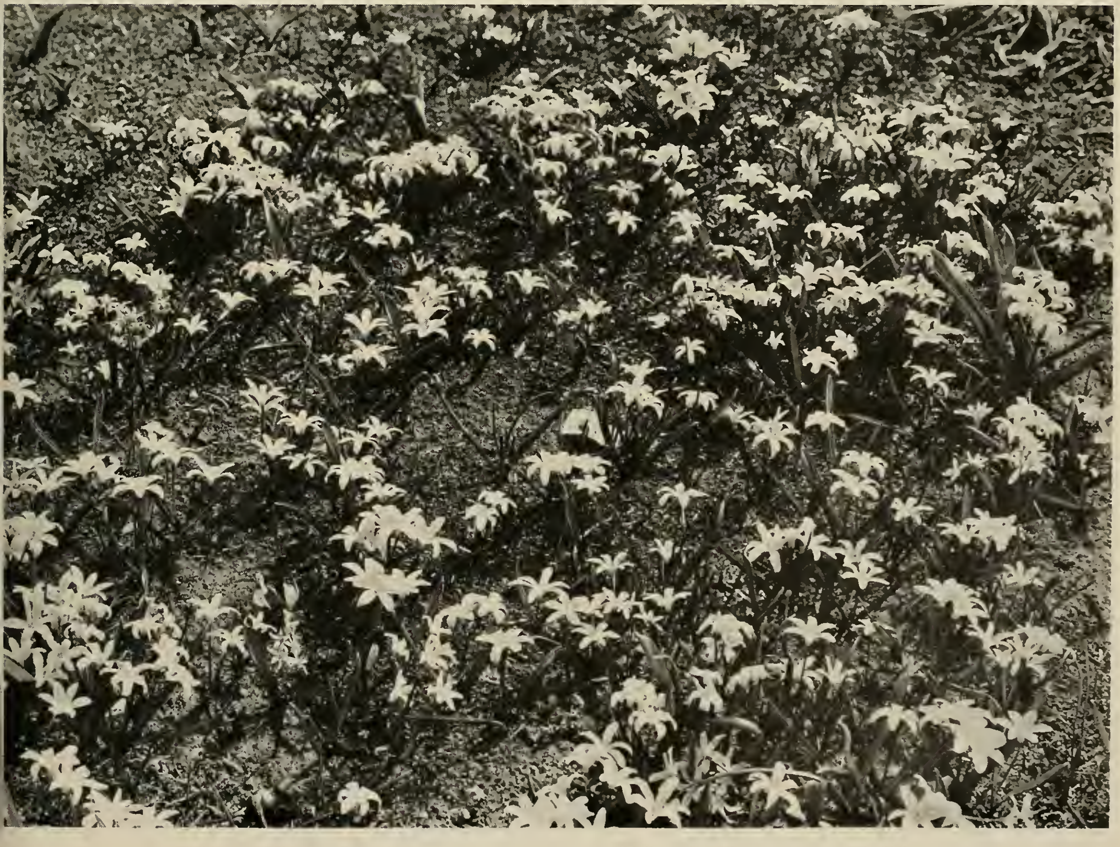
TULIPS

Meanwhile, the tulips have been brightening the scene — first the early single tulips, low in stature, pure in color, and like thin silk in the texture of their petals. After them come double-flowered forms of these varieties; then the cottage tulips, usually of medium size and great diversity of color. These are the ones most often seen bordering shrubbery, walls, and fences in the spring, and frequently used for long-season bedding effects. Last come the Darwins, magnificent, tall plants with large flowers of exquisite color. Darwins seem more a hothouse type of flower, yet it is perfectly possible, with the usual fall planting of bulbs under proper conditions, to produce beautiful Darwin tulips for late-May bloom around New York. The bulbs, however, must be renewed at least every other year. Bulbs of the smaller types of tulips may stay in the ground for several years without deterioration, if the leaves are not cut until after they have ripened.

Curious, unfamiliar tulips are now being seen in the intimate corners of rock gardens, where many amateur fanciers are now devoting themselves to species rather than to horticultural hybrids. One of the most charming of these is *Tulipa Clusiana* (widely shown of late years in border plantings at the International Flower Show in New York). This slender, graceful "Little Lady" tulip in cherry-and-white stripes is typical of the attractive species that it is possible to raise, if one will make the effort to obtain them and watch over them carefully. Such attention to species which have been little known in horticulture may bring interesting "new" types of tulips into general use.

How, in fact, did any of our garden flowers arise, except by gradual adoption and development of wild plants? Some of the prettiest of our spring flowers in the

Blue appears in the springtime garden when the grape hyacinths (right) and glories-of-the-snow (below) come into bloom



garden are native wild flowers that have been brought in from woods and fields. It has taken a long time, however, for Americans to learn to appreciate their own native plants. Even the humble skunk cabbage, whose mottled mahogany spathe adorns brooksides and marshy places before there is a sign of green roundabout, has been taken up gleefully by European gardeners, who like this strange — though evil-smelling — precursor of spring.

In fact, in many gardens across the ocean can be seen flowers familiar to every American who knows the woods and fields in spring. Bloodroot, anemones, and other favorites of native haunts have been introduced into gardens abroad with great success.

CULTIVATION OF WILD PLANTS

Of late, there has been a pronounced movement in this country to bring wild flowers into cultivation. Such was the purpose of the New York Botanical Garden's expedition into the southern Appalachians in the fall of 1933. Many wild plants from there are now being tested for garden use. Meanwhile, individual growers and a few nurseries are trying to discover the best means of cultivating wildings from all parts of the country — for they do not always take to civilization agreeably. As a result, many wild plants are now being offered for sale — and it should be added that this is usually the best way to procure them, rather than trying to transplant them from the woods oneself. Wild flowers are precious things, and unless an experienced hand is taking care of them in the garden, the lives of the tenderer ones, at least, are doomed.

FOR BORDER OR WILD GARDEN

Some, however, are easy to raise either by transplanting or by seed. The Virginia bluebell, *Mertensia virginica,* makes a successful and beautiful spring flower either in border or wild garden. The early wild blue phlox, *Phlox divaricata,* is equally delightful. Especially suited to naturalistic plantings are the wild geraniums and buttercups, while the dainty spring beauty, *Claytonia virginica,* makes a pleasant mass of pale pink in either a garden or a wooded spot. Columbine can be massed among other flowers in a border or scattered over a slope in a wild or rock garden. Meadow rue, which flowers early with inconspicuous little tassels, provides fine greenery for both the garden and house all summer long.

To many lovers of the out-of-doors, the violas and pasque-flowers frequently used in eastern gardens in spring are pleasantly reminiscent of the large violets and native pasque-flowers of the middle western prairies.

Submarine Power Plants

Fish that generate electricity with which to shock their enemies and overcome their prey

By C. W. Coates
New York Aquarium

OF ALL the devices employed by nature to protect its children or to insure their food supply, there is none more remarkable or less easily explained by investigators than the electric powers possessed by certain fishes. Living in a medium through which any man-made electricity passes with the greatest of ease, and through which man has the greatest difficulty to carry his electric power in cables without loss, these fishes have perfect control of their charges and discharges, using the electricity stored in their bodies as seems best to them in their fear or hunger.

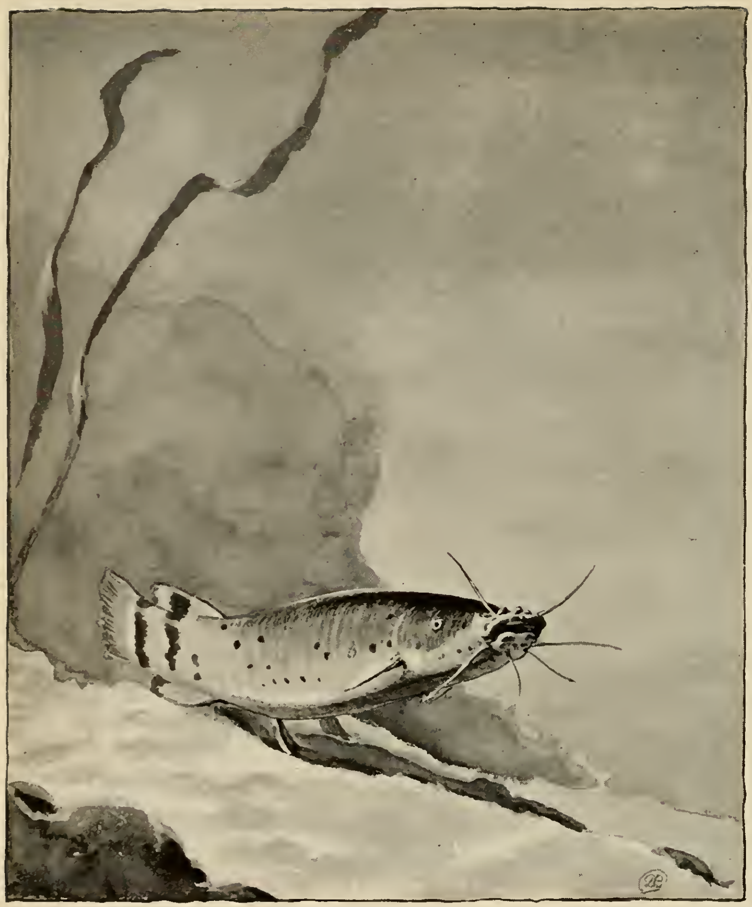
There are several kinds of electric fishes, but, while they have much in common, they are not closely related. There is an electric cousin of the common American bullhead living in Africa, in almost all the tropical fresh waters, and there are a number of electric rays scattered about the oceans of the world. These latter, the Torpedos and the related genera *Raia* and *Hypnos,* are probably the most commonly encountered of all the electric fishes, for one or another of them is found off almost all temperate and tropical coasts. They have even been encountered in British waters. The electric stargazers — Uranoscopids — may be stepped upon, buried up to their eyes in the sand of our coastal waters, but their electric power is not to be compared with that of some of the other fishes. The electric eel of northern South America is, however, the most famous of them all. Some of the Nile Mormyrids have small electric batteries. The deep impression made upon the ancient Egyptians by these fishes is indicated by bronzes and paintings. Pictures of the fish were incorporated in their hieroglyphics.

The Arabs of old knew of the electric catfish, which occurs also in the Upper Nile, and called it "thunder fish." Compared with even a small catfish, the Mormyrid would have felt like a small flash-lamp battery, and a full-sized catfish of three feet might have put a new god in the pantheon of the Egyptians. On the other hand, if either the Arabs or the Egyptians had met a vigorous electric eel in the full flush of its electricity, their Mormyrid and thunder fish would have seemed pallid and insignificant indeed.

All of the electric fishes except the catfish (*Malapterurus electricus*) have electric organs of muscle tissue which has become modified into electric tissue. These are usually in the tail region, although that of the Torpedo is in the head. The battery of the catfish is a sheathlike affair which covers almost the whole body between the skin and the underlying muscles. All the organs, wherever situated and of whatever kind, are controlled by the nervous system of the fish, and the method of production of electricity seems to be similar in all cases. It is generated and stored in the cells of these tissues which, when a discharge is liberated, seem to develop a polarity of their own, the negative of one touching the positive of the next, and the discharge is thus of a myriad of tiny storage batteries. The eel alone seems to have power to regulate the intensity of the shock, but how this is done is still a mystery.

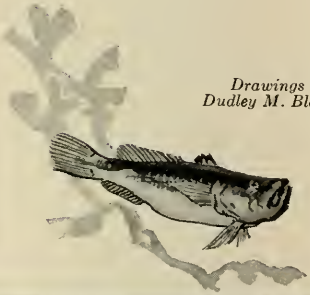
However, although the electric organs have a definite location in the anatomy of each fish, we have been unable to find any part of any electric fish which does not become electrified when touched. There is not, apparently, any insulated material in the animal's body.

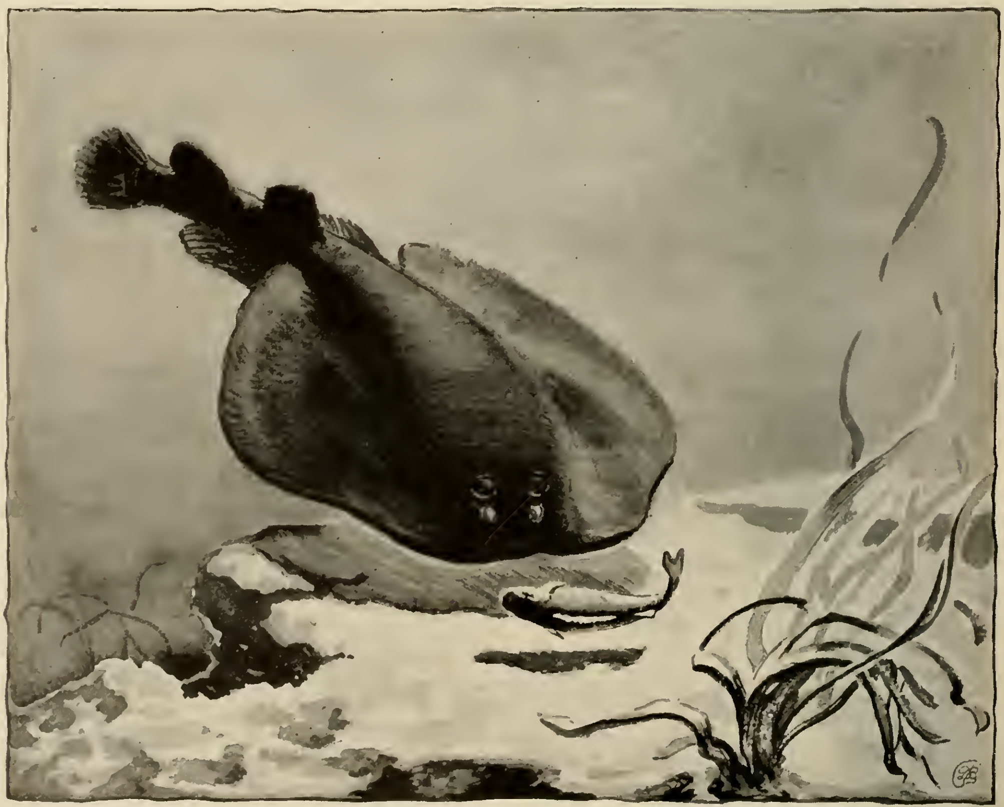
As far as we know, the electric eel is the only one of this group of remarkable creatures which uses its power in the pursuit of food, although the Torpedo may do this to a minor extent. The others seem to use it solely as a defense mechanism — a very ef-

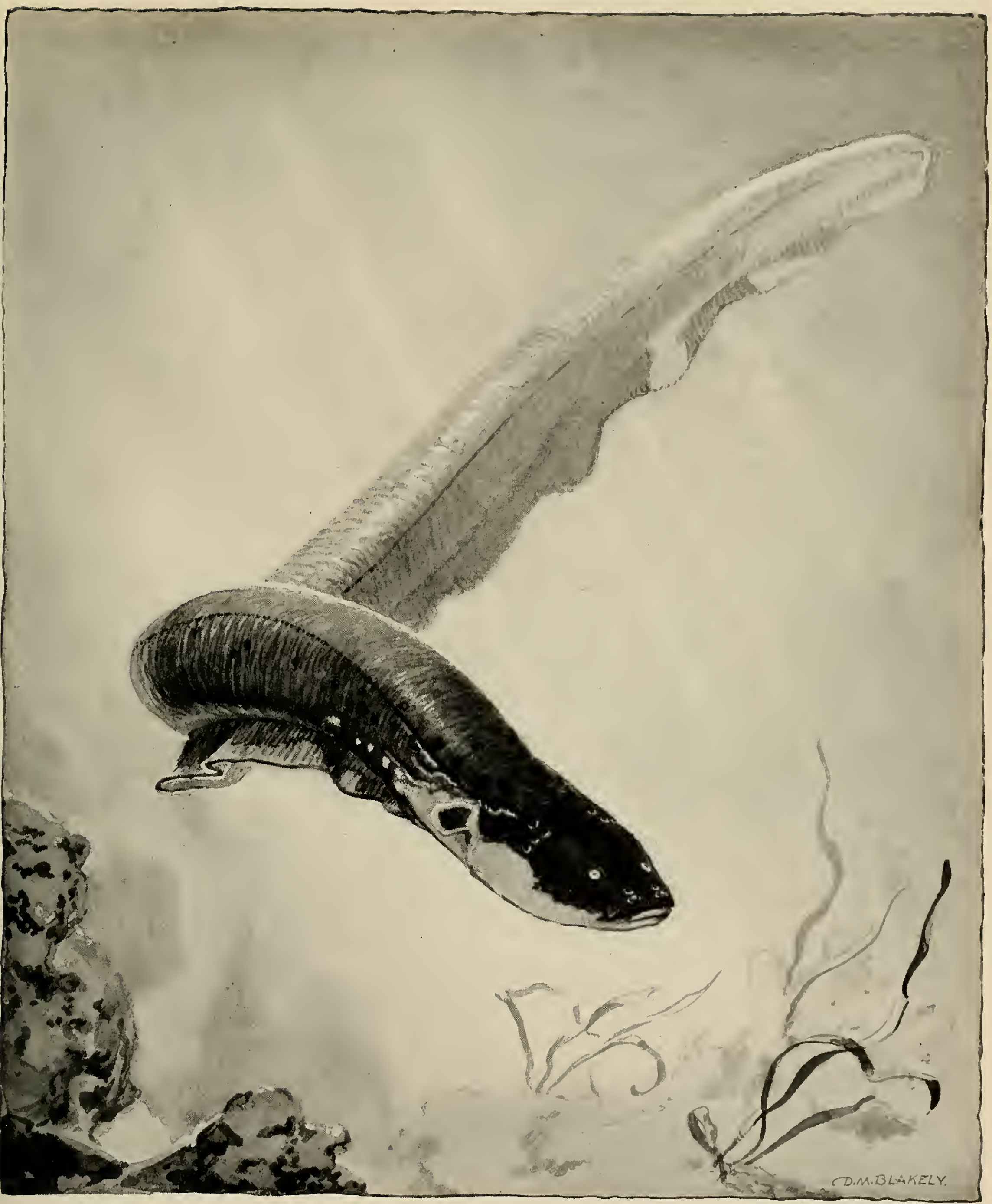


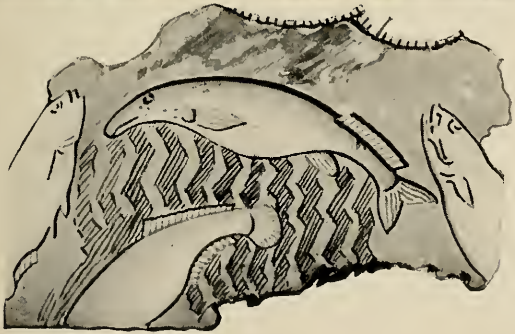
The electric catfish shown at the left inhabits the fresh waters of Africa. The Arabs call it the raab, or thunder fish. The large picture at the bottom of the page shows the Torpedo which, though it is capable of transmitting a sharp shock when interfered with, soon exhausts its batteries. There seems, however, to be some question about the electric powers of the stargazer, shown immediately below. Those who have stepped on it with bare feet, however, are in no doubt whatever

Drawings by
Dudley M. Blakeley









The long, lithe fish shown above is the electric eel, which is to be found in many of the rivers of northern South America. It is, by a wide margin, the most powerful living generator of electricity. At the left is shown a copy of an Egyptian wall carving of a Mormyrid. Despite the rather weak electric powers of this fish, it was still sufficiently striking to be venerated by the ancient Egyptians ficient defense, it may be said, for, upon one's touching the fishes, they liberate enough electricity to make one let go in a hurry, even though the shock is expected.

The eel, besides this defense activity, discharges a shock when an animal which may be suitable for food swims anywhere near it. The unfortunate victim, immediately paralyzed, is then an easy prey to be inspected at leisure. If, for any reason, the eel does not swallow the paralyzed animal, it will recover in ten or fifteen minutes, none the worse for its experience.

Both the eel and the catfish have been the subject of much more study than any of the other electric fishes, probably because they are more easily kept in captivity. The Mormyrid is a delicate creature which may be kept alive in an aquarium only for a day or two at most, and that with the greatest difficulty. *Raia* and *Hypnos* have not strong batteries. The Torpedos, which have strong batteries, do not seem to be particularly happy in captivity and do not survive long. The catfish, however, provided it is given a tank to itself, seems to thrive well. It is a curious thing that two or more of these electric catfish never seem to get along together at all, for invariably, if they are kept in the same aquarium, they will shock each other so much that in less than a week there usually is only one left. When a catfish is the subject of a discharge from another catfish, that part of the skin which was in contact and received the shock seems to be partly destroyed and becomes loose and broken, and the fish dies soon thereafter. This has been recorded for many years by observers who have commented upon it without explaining it. Nor have they been able to advance any theory to cover the apparent immunity enjoyed by the fish while in transit, for usually a number of these creatures are shipped in the same container without suffering damage. It seems that they become dangerous to each other only in the comparative comfort of an aquarium. It may be that they are so miserable aboard ship that they have no energy left to discharge electricity.

Contrarywise, the eel is in full possession of its powers when it travels, as has been proved by costly experiment. Seeking to prove or disprove the electric power of the fish, a doubting Thomas will seize one in his hand, and then an eel is usually lost, for the current immediately turned on by the eel causes the muscles of the hand to contract and squeeze the fish. This in turn causes the eel to release more electricity, and in a few minutes the unfortunate fish may be almost squeezed in two. The electricity ceases, of course, when the eel dies.

When these fish do arrive in the tanks of an aquarium, they do very well. Two which were taken to London many years ago, when they weighed less than one pound each, grew so rapidly that six years afterward they weighed about fifty pounds each. One animal in the New York Aquarium increased in length from less than three feet to more than five feet in two years.

Contrary to the catfish, the eels live well together. Indeed, they seem to derive certain benefits from the company of their kind, for, when several are kept together, only one or two will discharge enough electricity to paralyze sufficient food for all, the others apparently keeping their electricity in reserve. Perhaps they know that their electric organs may be run down like a battery, and that it takes about two hours for them to generate a fresh supply of electricity, meanwhile leaving the fish absolutely defenseless.

These animals are exceedingly difficult to handle, for one does not have to be in contact with the fish to feel the shock. It may be felt from the water or from the dry, wooden handle of a net and, if there is the slightest moisture about, through rubber gloves. Persons skilled in handling the creatures will purposely disturb them considerably before attempting to remove them from the water, so that as much electricity as possible may be discharged harmlessly. This is not the case with the electric catfish, whose electricity is not noticed to any great extent unless one is in direct contact.

There is still a great deal to learn about the natural electricity of these electric fishes, for their energy, which seems to follow all of the laws of ordinary electricity as we know it, still seems to have peculiar properties of its own which follow no known electrical laws.

The Mountains of Glacier Park

An account of one of the youngest sections of the Rocky Mountains, and the steps by which these peaks have developed

By Carroll Lane Fenton

Courtesy Glacier Nat'l Park, Photo by Hileman

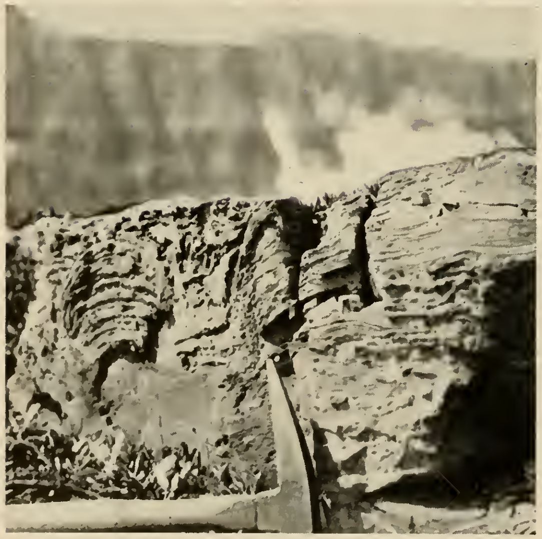
AS THE traveler in northwestern Montana nears Glacier National Park, he sees a mountain wall rising without foothills from the plains. Between them runs a line so sharp that he feels he can put his hand upon it, once he reaches the foot of the range.

Just as the line becomes most clear, a western village intervenes. Its sunburned buildings of logs and boards have never known the coolness of shade. Its chief street swims in a haze of dust, in which horses, cars, and paintless wagons stand before the trading post. Men in high-heeled boots lean against brown walls, speculating on the number of "dudes" that will come on the afternoon train. Said one, "Them rock-hunters was comin' back for more of them things they call fossil plants. . . ."

Thus the geologist is welcomed to mountains that are both beautiful and young. Barely 60,000,000 years have passed since this section of the Rocky Mountains first appeared as a low chain of hills; many of their peaks took form within the last thousand centuries. If these figures still seem large, recall that the Appalachians have passed the 200,000,000 mark, and yet are by no means the world's oldest highland.

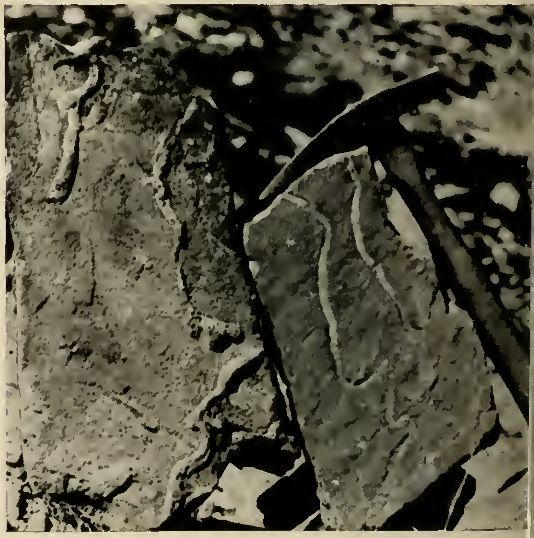
Despite their comparative youth, these ranges hold rocks that are very old. Formed in Proterozoic times, their age may be estimated at about 600,000,000 years. When they gathered, Montana was the site of a sea stretching southward from the Arctic Ocean, perhaps joining waters with a bay advancing from Arizona. Into this basin many rivers drained, bringing loads of sand, silt, dolomite, and lime, that hardened into strata of stone. For millions of years these strata grew, until they formed a varied series of rocks with a full thickness of 60,000 feet.

Pages from a



A ledge of limestone, built originally by marine plants some 600,000,000 years ago, but now lying on an alpine pass. These fossil plants give glimpses of the life that existed in this region during Proterozoic time

The two slabs of sandstone in the photograph below show the borings of marine worms, made before the solidification of the material of which the rock is formed

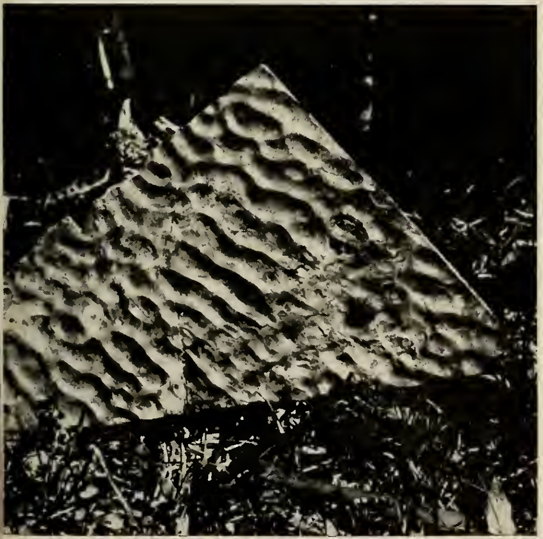


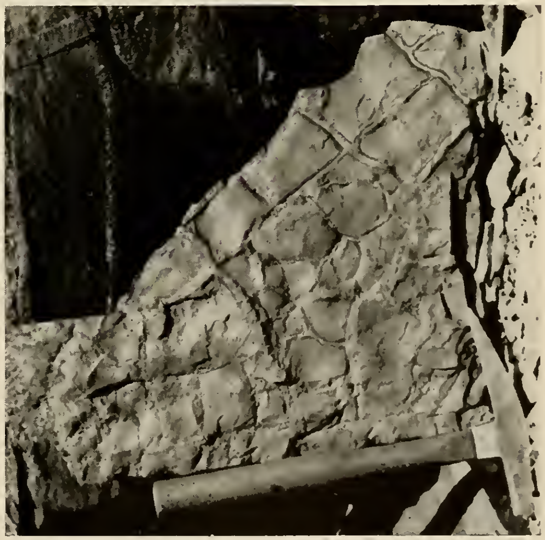
To the geologist, the rocks of such mountains as these tell a great deal of the story of their origin. The stratification, shown so plainly across the face of the tall peak, contains a whole page of geologic history, while the folds, the fossils, and other geologic details add further to the story

Courtesy Glacier Nat'l Park, Photo by Hileman

Geologic History

The triangular slab of stone below bears ripple marks formed by the waters of some ancient lake or sea that once existed where Glacier Park now lies





(Above) Ages ago this slab of rock was mud. As it dried, the cracked edges turned down — evidence that the water in which it formed was salty. Where fresh-water lakes dry up, the edges of the cracked mud turn upward

More doubtless were added in later ages, whose record has vanished from the mountains of today. But at last sinking gave way to uplift; rocks that had lain beneath the sea were pushed upward into land. On that land appeared dinosaurs with short front legs and ducklike beaks, and others whose bodies were sheathed in armor. They wandered through swampy glades where today are the plains of Glacier County, Montana — and they fled before a Cretaceous sea whose muds now lie beneath the mountains.

THE RETREAT OF THE SEA

Soon that sea itself retreated before a vast earth-shove from the westward. Before it, hard rocks bent upward in folds. Pushed farther, they crumpled and broke, slipping and grinding their way over beds that once had been above them. When the earthquakes of uplift stopped, the rocks had traveled upward many thousands of feet and eastward at least thirty miles. Mountains of Proterozoic stone stood upon crumpled Chalk-age shales. Between them lay the Lewis Fault: the break along which the mountain mass had moved. Its front became the line one sees as one approaches Glacier Park from the east.

Later came the glaciers themselves, deepening chasms first cut by streams, planing the cliffs below every peak. Once they melted but reappeared; today sixty small ones survive, remnants of a vanished Ice age. Their work, as well as that of old seas, accounts for the scenic features of the Park.

Scenic beauties made first appeal when, sending our camp outfit by bus, we took the trail to Two Medicine Valley. At our feet were cliffs of buff limestone and marble; above were slopes of satiny green, dipping westward to a glacial lake. On these green foundations stood mountains of red, topped by gray and ochre pinnacles. Other red peaks, hung with snow, formed the distant Continental Divide.

Each color had its special meaning — as we learned in following the trails from our camp among the lodgepole pines. The buff limestones tell of a quiet sea, to which streams brought only dissolved lime and the mineral called dolomite. But sometimes that calm disappeared; gales from a semi-desert shore carried clouds of sand and even small stones, to drop them upon the lime. Their rough grains on weathered ledges still record those ancient storms.

Shallow water must have been the rule in Montana's Proterozoic sea. Beds of lime-, mud-, and sandstone unite in bearing ripple marks that were made when breezes swept broad shoals. When the wind changed, waves built new ripples across those already formed; on a pass not far from another camp we found beds of cross ripples so perfectly built that their crests form almost exact squares. Breezes must have been uncertain indeed on that special shoal.

Currents also swept near shore, building ripples with one side steep, not symmetrical like those of waves. We found the best ones near a glacier so small that, until we climbed and looked down upon it, we thought it a mere patch of snow.

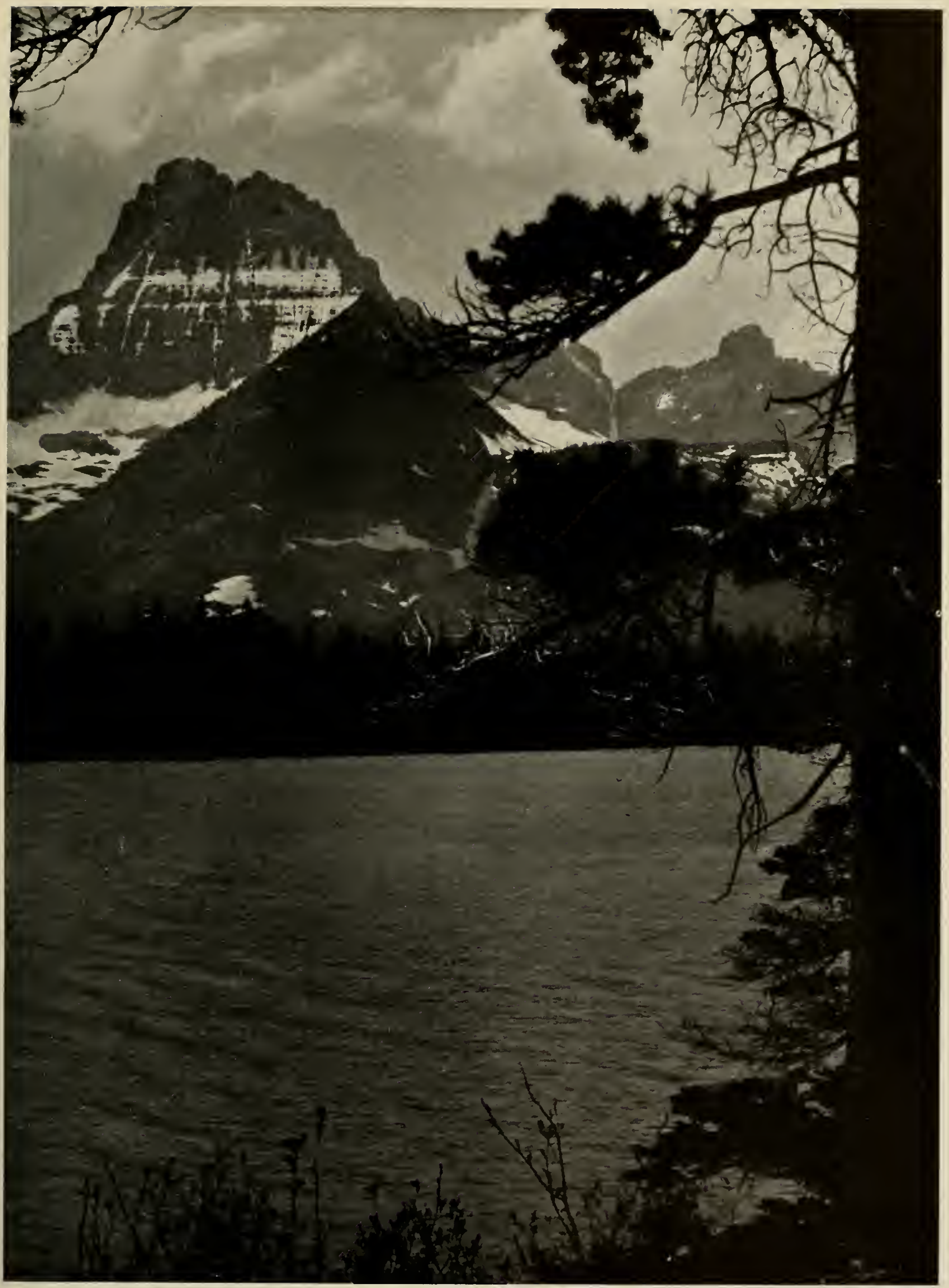
But what were the dark red chips and balls, buried in layers of sand? They seemed to have rolled, snowball style, across a bottom of sticky mud. Storms set them upon this path of growth; reaching shallows, they stranded in the sand. Among them settled bent bits of mud, also torn up and dropped by the waves. Even limestones and shales show such scattered chips, as we found when we came to follow the trails along the Continental Divide.

A RECORD OF STORMS

Over thousands of miles and through millions of years, the Proterozoic waters remained so shallow that the slightest uplift drove them away. Then the sea floors lay bare in the sun, to be pitted by hailstones and drops of rain before they hardened. A single ledge often showed us records of storms on both land and sea, in its mud balls, pebbles, and pits made by rain.

It also might show that the barren muds cracked, as pond floors do when they dry today. But the edges of cracked pond muds curl up; those ancient ones lay flat or turned down. To find such marks in formation today, we must go where marine or brackish muds lie exposed to the air and sun.

But must the mudstones of Glacier Park be marine? The late Doctor Walcott thought

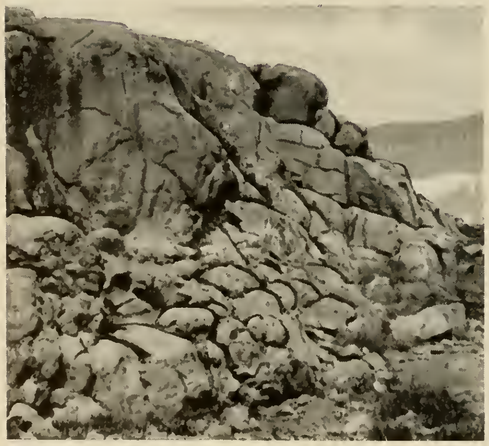


© Hileman

Swiftcurrent Lake

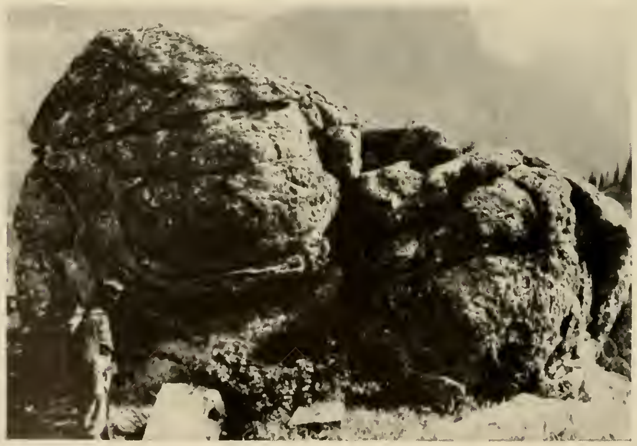
At the foot of Mounts Wilbur and McDermott lies Swiftcurrent Lake. Sixty small glaciers still survive in Glacier Park, marking the remnants of a vanished Ice age. Between the peaks lies Iceberg Lake, fed by one of these remnant glaciers. See page 219

© Hileman



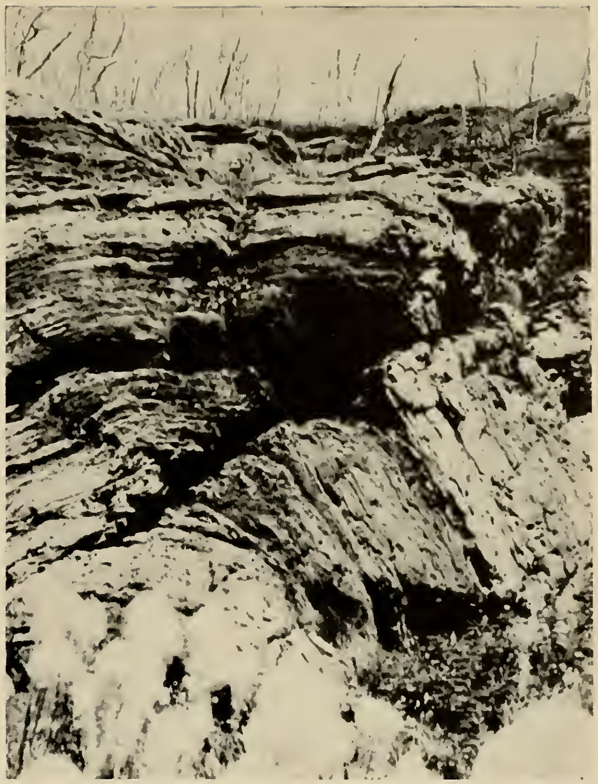
(Left) Here a flow of submarine lava is shown. The lumps or "pillows" characterize lava that hardens under water

(Below) Two masses of fossil algae now estimated to be 600,000,000 years old



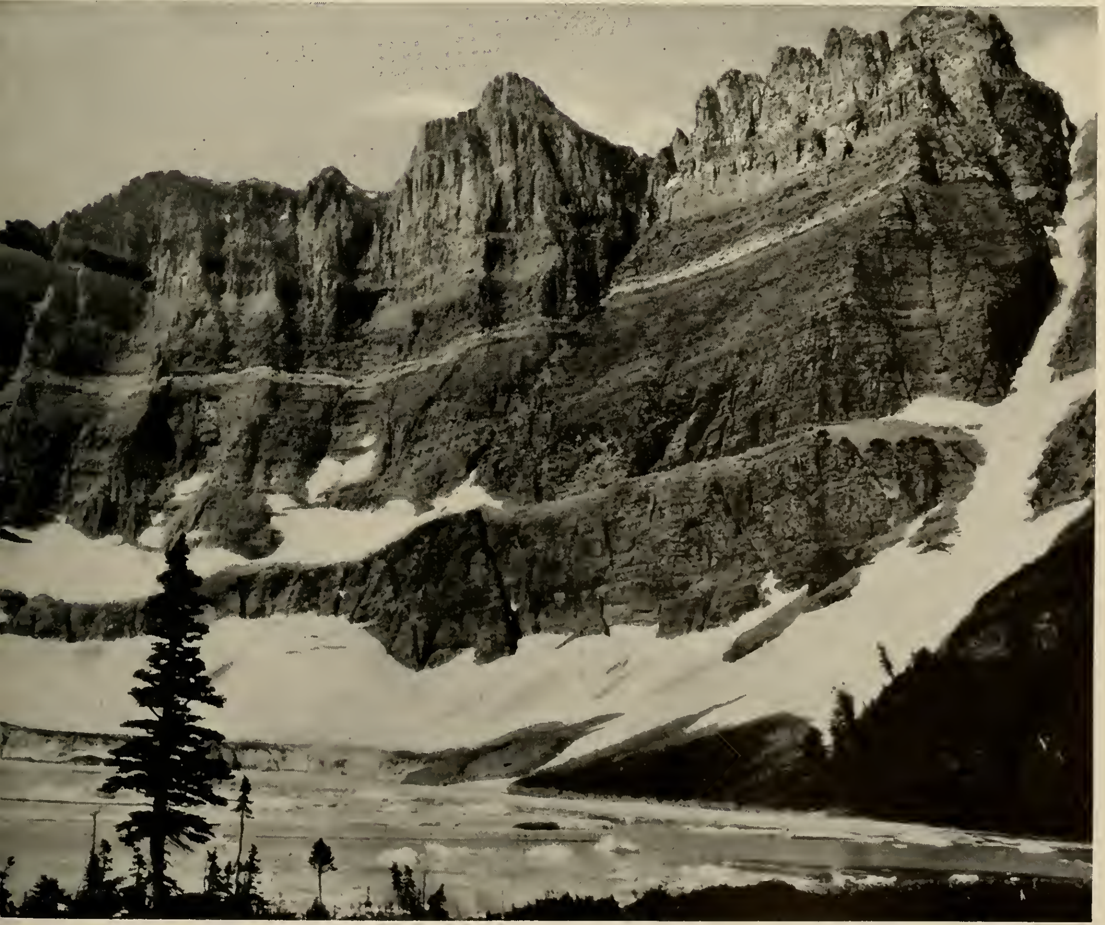
(*Left*) *In Granite Park. The stone chalet is perched on a hardened lava flow. Near it are beds of green shale containing many fossil algae*

(*Right*) *Uplifted by the giant forces of nature, rocks are to be found bent and broken even in places that lie miles from the present front of the mountains*



(*Below*) *A section of the Continental Divide. At the foot of limestone walls 2000 feet high lies Iceberg Lake. Across the face of the cliff are well marked strata formed by the remains of compactly grown plants which flourished ages ago*

© Hileman



they, and the limestones, had formed in huge lakes. Prof. Joseph Barrell compared them to the beds left when streams overflow and cover wide plains with silt.

We have kept both theories in mind through four summers of geologic work by trail, and frequent study in the laboratory. We are not yet sure that the problem is solved — but we have found no evidence of lakes, and a great deal of seas. And Barrell's streams were strangely salty, for the very beds he ascribed to floods abound in saline mud cracks, and casts of what once were crystals of salt. If stream deposits exist (and they may!) we have been unable to distinguish them from others laid down in bays.

But what do the fossils say? For animals, they are sadly incomplete: two slabs bearing burrows of worms that we found while on our way to a pass where we hoped to photograph mountain sheep. One rock bears what may be trails and burrows of mud-dwelling clams, the oldest of their kind in the world. Supposed crustaceans described by Doctor Walcott proved to be broken fronds of plants — apparently brownish-green seaweeds.

Their fossils lie at the foot of a cliff near the scenic center called Many Glaciers. A few feet above rise massive beds formed by closely packed, oblique columns. Each column is oval in section, consisting of hundreds of thin layers like saucers piled bottom-side-up. They were built by colonies of algæ, which formed layer on layer of lime as they grew. Thus, even while alive, they formed compact beds of stone.

The thick green and red formations have not given us one fossil plant. But scarcely did lime bottoms return when a new sort of alga appeared, building "biscuits," domes, or compact beds. Scattered widely through the Park, these fossils are most abundant on two of its southern passes. There they lie among dwarf willows and snow, above slopes where queer little alpine plants sink roots two feet into the ground to anchor a three-inch crown of leaves. When we first found them, a mountain goat stood on a ledge formed by these marine fossils!

Though these algæ lived in shallows, they had no such problems as those which faced a species found in greenish shales near the crest of the Continental Divide. They dwelt in a windy bay, on layers of hardened and cracked mud that a few months before had been land. When waves swept inshore, they were overturned; submarine lava flows burst forth, burning them to red, brittle balls. Yet between eruptions the algæ returned, only to meet a similar fate when new cracks opened and lavas emerged.

The tale of these struggles and defeats is told on a fir-grown slope called Granite Park, where a chalet built of red sandstone stands upon the tumbled lavas. Visitors often marvel at the view — but few realize the dramatic past recorded by those peaks and ridges of stone.

From Granite Park a fern-fringed trail leads to the Going-to-the-Sun Highway. There, in 1932, we discovered two fossil reefs, more perfect than those diagrammed in textbooks. Our roadster stopped with a jerk; out came notebooks, hammers, and tape for the capture of this new, rare find. The most perfect reefs we ever had seen — 600,000,000 years old!

RECORDS OF THE PAST

As we measured, sketched, photographed, we noted how the plants of the reefs had varied to meet each different need. Where crowded, they grew in compact cones; on exposed spots, they formed wrinkled sheets. Higher, they took on spongelike form, while out on the open, uncrowded mud, they grew in flattish biscuit shapes. Such biscuits, we already knew, sometimes grew to enormous size. Had we not seen two, ten feet in width, in a basin where a glacier once headed, below windswept Boulder Pass?

In our camp among cedars and Douglas firs, we reviewed the meaning of those reefs. Not merely did they prove four "species" one, through the intricacies of variation. They gave us a picture of simple organisms, meeting the problems of life long ago as simple organisms meet them today. We had traced shallows, waves, floods, eruptions in the rocks; at last we knew with some confidence their effects on the plants living on and among them.

But animals? They still offer a problem, to solve which we plan new seasons of work in the mountains of Glacier National Park.

The Story of Silk

Based on the skilled ability of countless adept workers, upon whose care and dexterity the excellence of the raw material almost entirely depends, silk has, for thousands of years, been used to create the world's preëminent fabrics

By Donald D. Leonard

THE origin of silk is lost in antiquity. Legend tells us that some 4000 years ago the Chinese princess, Se-Ling, dropped a cocoon which she had found in her garden, into her cup of tea, and discovered that it was possible for her to unwind the strong, continuous fiber from the softened exterior.

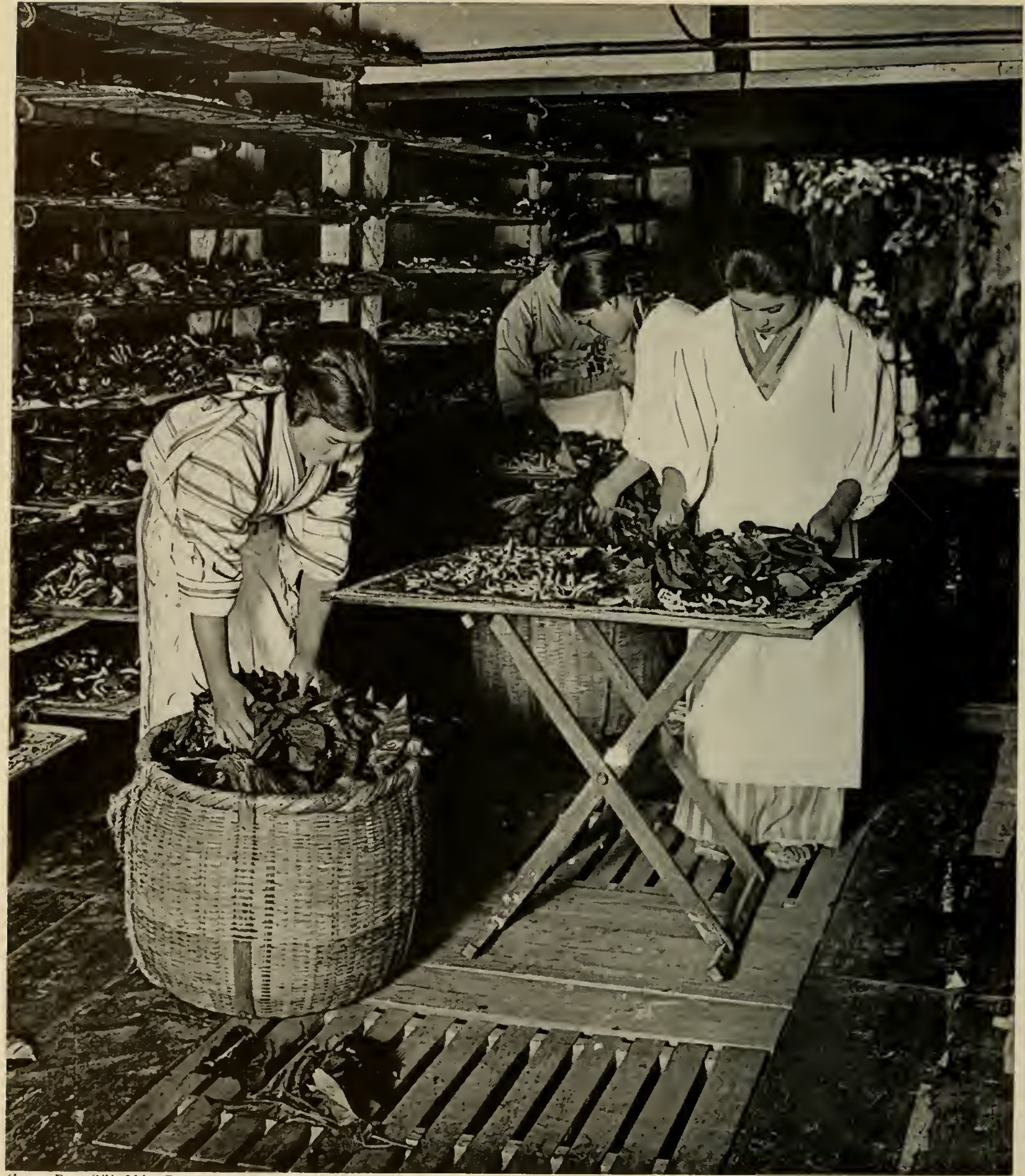
The ability to convert the cocoon filament into yarn, and thence into fabric, developed by slow stages, but there is ample evidence that silk cloth from the hand looms of China was an important part of the load transported by the camel caravans to the mighty Persians, and later to the imperial Romans. Pompey returned from his Asian campaign in 81 B.C. wearing a gorgeous silk robe, which apparently established the style among the elite of the day, for a silk fabric dyed purple commanded a price at the rate of $1,800 a pound. During Justinian's reign, about 550 A.D., two itinerant monks succeeded in smuggling out of China some silkworm eggs in the handles of their canes, thus establishing the entomological origin of the beautiful fiber. It is uncertain whether the good Fathers were properly rewarded for their patriotic service, but for some time their information proved to be of only academic value to their rulers, since the proper feeding of the young worms had to be learned, and the technique of converting the cocoon into yarn had to be developed. The seed of the European branch of the industry, however, had been planted.

Meanwhile, in China, the domestication of silk-producing moths was developing into an industry which was intimately to affect the lives of millions. Several species of moths were employed at first in the production of the fundamental cocoon, but gradually attention was concentrated on one moth, *Bombyx mori,* which is, today, the species that is universally bred and used by sericulturists the world over. *Bombyx mori* is as unconcious an ally in the provision of human wants as the sheep which grows a warm coat of wool, for, in the natural sequence of its life-cycle, the larva spins a covering to protect it during its remarkable change into chrysalis, and again into moth. In his treatment of this protective covering of the dormant worm, man is, however, more ruthless than with the sheep, for the worm or its chrysalis is destroyed in obtaining the fiber.

To obtain this fiber, the procedure in its fundamental steps remains the same as that of the earliest farmer who realized that the production of cocoons meant a cash crop with which to supplement his meager yield from rice or garden truck. These steps were to harvest the cocoons when completed and to soften them in hot water, so that the continuous fiber which the worm had spun could be smoothly unwound on to a drum or spool.

The great improvement in technique came when the farmer realized the disadvantage of having to search for the casual occurrence of cocoons on the natural and only food of the *Bombyx,* the mulberry, *Morus alba.* He then permitted some of the moths to emerge from their silken envelopes, to mate, and to lay eggs. These were hatched into tiny worms, known as "ants," which greedily consumed many times their weight of the fresh mulberry leaves that were fed to them.

During five stages of feeding, interrupted by four moults, the voracious insects matured in little more than one month into a grayish-white, firm-bodied caterpillar about

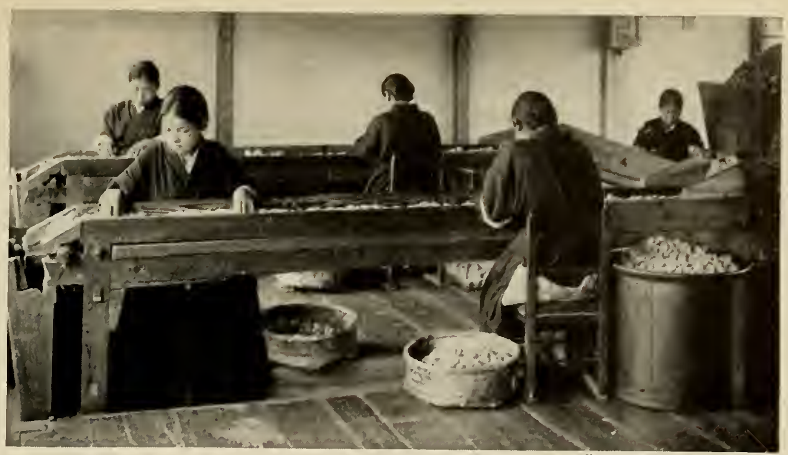


Gunze Raw Silk Mfg. Co.

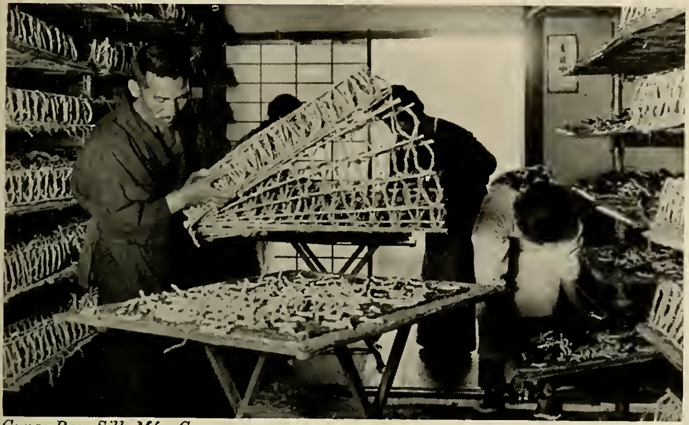
The only satisfactory food for the silkworm is mulberry leaves. At the right is shown a farm in Japan where this food is grown in large quantities. Above, workers are engaged in feeding large leaves to almost full-grown worms

Morimura, Arai, and Co.

(Below) Providing a convenient structure or frame to which the full-grown worms may attach their cocoons. This process is known as mounting

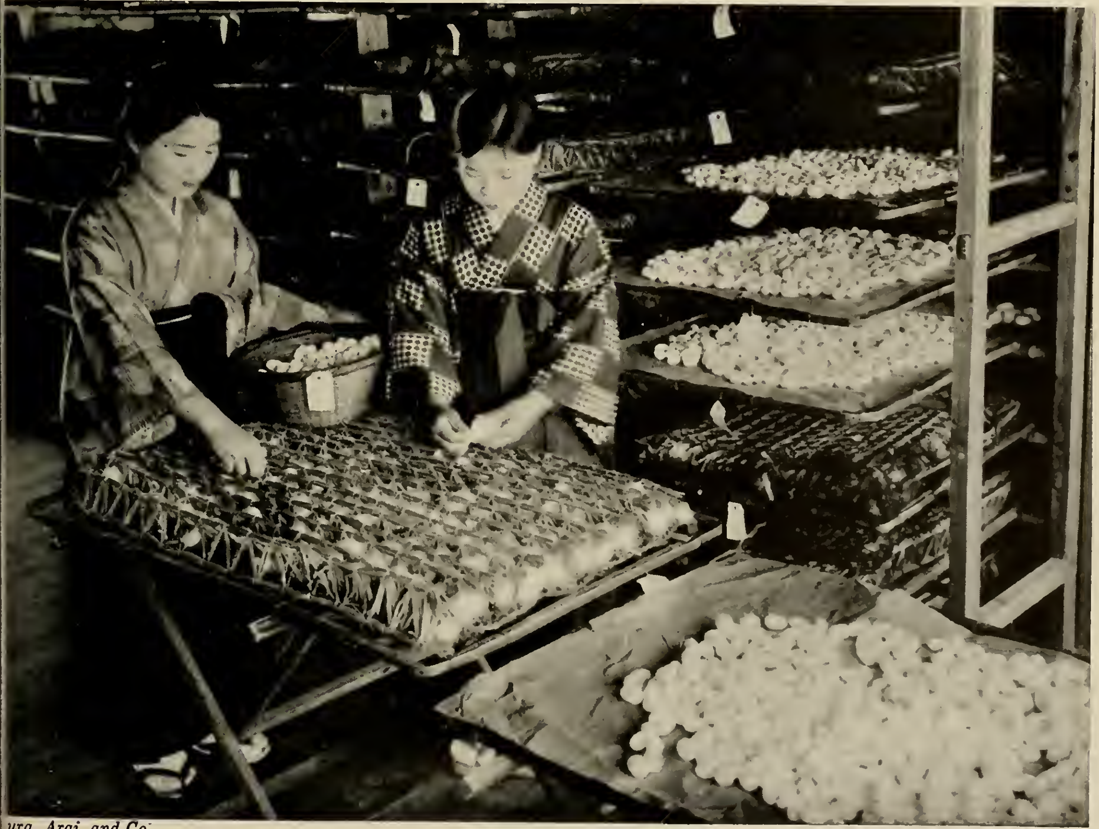


Gunze Raw Silk Mfg. Co



Gunze Raw Silk Mfg. Co.

(Below) Here finished cocoons, ready to be sent to the sorting room, are being plucked from the frames. Above is a glimpse of the sorting room, where experienced girls are sorting the cocoons according to color, size, shape, and texture, to facilitate the reeling of uniform raw silk



ura, Arai, and Co.

three and one half inches long, which lost its interest in food and sought a cluster of projecting twigs to which to attach the scaffold of its temporary home.

The farmer who had successfully controlled the location of the mating of the adults and the rearing of the young, next saved himself much of the time and effort he had expended in looking around the farm for the cocoons, by providing suitable cut branches, and then straw frames, on which he carefully dropped the worms ready to spin. When the resulting cocoons were collected, some chosen for reproduction and the remainder prepared for reeling, the strictly agricultural phase of the industry was completed.

Eventually, tremendously increased demand for silk forced the development of large scale business in the production of cocoons, and the outlay of cash by the farmer-sericulturist for more silkworm eggs and mulberry leaves than he could provide on his own land.

The success of the crop was subject to much the same variables that confront the raisers of cotton or wheat, or hogs, with the additional hazard arising from the fact that the silk fiber exudes from the interior of a caterpillar which is subject to indigestion, and attacks by fungus and parasite, and with a constitution so delicate that a severe thunderstorm may seriously disturb the even flow of its liquid filaments.

HOW THE INDUSTRY DEVELOPED

For centuries these problems were solved to a great extent by the experience gradually acquired by the farmer and his family, particularly the women, who were especially fitted for the care and skill necessary in handling the little insects. During the Nineteenth Century, growing demands for more and better silk fabrics caused some degree of specialization and coöperation by those farmers who, by good luck and application of semi-scientific principles, had become sellers of the white or yellow ovals to other men, who decided their best profit lay in the industrial conversion of the cocoon by uniting many fibers into the thread that is known as raw silk.

This separation of the industry was not abrupt, either chronologically or socially. Some Chinese farmers undoubtedly continued to raise cocoons from which their wives made yarn for their garments, while contemporary peasants in the Near East were shipping all their cocoons into Italian reeling factories, called filatures. At the same time some Japanese rice growers, for example, probably were producing a side crop of cocoons both for their domestic use and for sale to their urban cousins who operated a reeling plant. And even today there continues this uncertain and changeable status of consumer or seller, which exists so peculiarly in agricultural pursuits.

CHANGES IN SUPPLY AND DEMAND

This uncertain status exists not only among individuals, but also in the case of countries, so that, in the course of five-year periods a nation which has been a large producer of cocoons and an exporter of raw silk, has become an importer of raw silk. This change has been due to factors other than mere supply of cocoons, in one country, and demand for the reeled fiber in another country. Soviet Russia, for example, has been a large producer of cocoons for many years, but only within the last three years has it shipped raw silk to the United States. It is reasonable to believe that the demands of the Five Year Plan have made desirable the building up here of as large a cash balance as possible in United States dollars, to be used for the purchase of heavy machinery and other American goods, and that the Russian raw silk has been employed as a governmental cash crop for revenue and trade balance.

When a study is made of the occurrence of sericulture throughout the world, it is interesting to realize the extremely widespread distribution of this ancient industry: the world is literally circled by silken threads. From the standpoint of quantity of cocoons produced, the present status is approximately as follows, listing the greatest producer first, to the smallest: Japan, Italy, Corea, China, U.S.S.R., Persia, Turkey, Greece, Syria, Bulgaria, Macedonia, France, Brazil, Jugoslavia, Spain, Rumania, Egypt, and Czechoslovakia. From the standpoint of exporters of raw silk to America, the list is much smaller, and includes, in order of importance, only Japan, China, Italy, and U.S.S.R.

Japan is by far the greatest silk producing and shipping country. United States is by far the greatest importer and consumer of silk, and yet there is no American raw silk industry. This absolute dependence on other countries for raw silk has been the reason for many attempts in the past to establish a domestic source of supply, and important political pressure has been used to bring about an import duty on the fiber, so that an infant native industry might be nurtured.

PROMISES OF WEALTH

The agitation usually started from the sale of mulberry trees, or slips from trees, which were to be planted as a start of a separate business that promised fabulous profits to those who were in on the ground floor. The fortunate owners of the mulberry trees were to sell their leaves as food to those who were going to raise the worms. Country-wide interest developed in the Eighteen-sixties, and fortunes were made and lost speculating in a food for caterpillars which never existed. Even during the last fifteen years, serious attempts have been made in California to introduce mass production methods into sericulture, but all efforts have failed, not because we do not have enough mulberry, for it can be grown; not because cocoons cannot be produced here, for fair samples have been displayed from, at least, New York, Alabama, and California; but because American labor cannot compete with the low cost of Asiatic labor in the most important phase of the whole industry — that of reeling the cocoon into raw silk of a quality that our market demands.

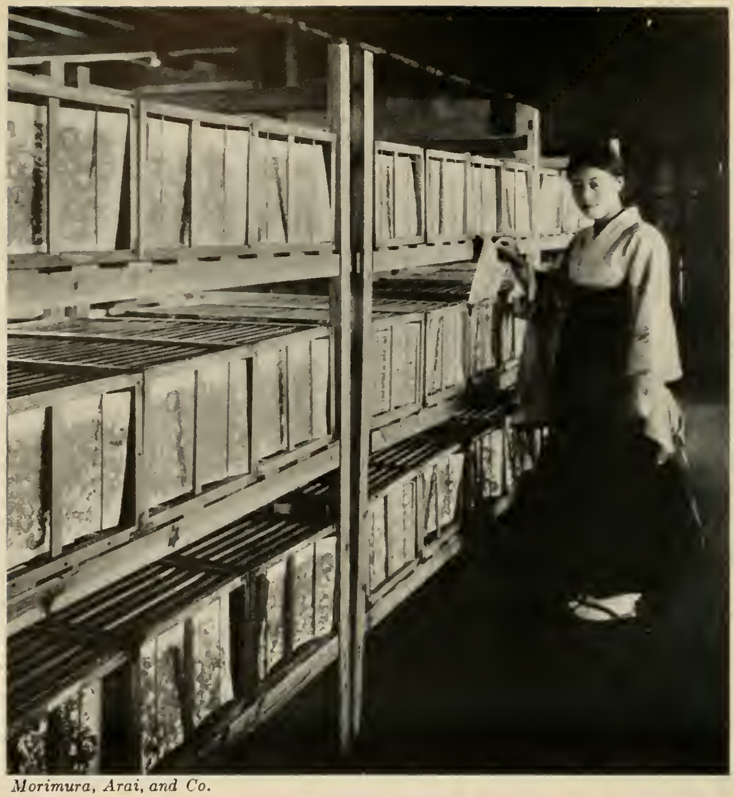
A consideration of the various steps in the large-scale production of cocoons and the technique of reeling the raw silk suitable for our use, will convince the most patriotic American that no tariff walls should be raised against this product of our foreign suppliers.

The first step in which the manager of a reeling factory is interested is the first step in the life cycle of the *Bombyx mori* — the egg. In Japan especially, where the government has a decidedly paternalistic interest in the industry, the production of silkworm eggs is controlled in many cases with the exactitude of a pharmaceutical laboratory. This is best demonstrated in the case of the largest reeling organizations, which breed their own worms, and raise their own disease-free eggs, in order to safeguard particularly against an hereditary affliction which often permits the larvæ sufficient term of life to consume quantities of expensive mulberry leaves, only to die before spinning its envelope. The freedom from disease is effected by a post-mortem examination of a solution of the body of the female parent, whose eggs have been laid on a numbered square on a cardboard, and which eggs can be removed from the egg card and destroyed if the parent is found to be unhealthy. The good eggs are then sold to farmer-coöperatives, who operate with the filatures on some arrangement by which they agree to sell to that filature the ovals spun by the worms hatched from the eggs. This arrangement assures the reeler of at least a minimum supply of cocoons produced in the area surrounding his mill, and helps to insure uniformity of quality and availability.

The functioning of these farmer-coöperatives is the weak link in the chain of complete control of the industry which so nearly is attained by the reeling organizations, for, except in a very limited degree, the reeler is dependent on many farmers and their families for their raw material — cocoons — which are the greatest single item of cost in making raw silk, about 75 per cent of the total expense.

A "HOME" INDUSTRY

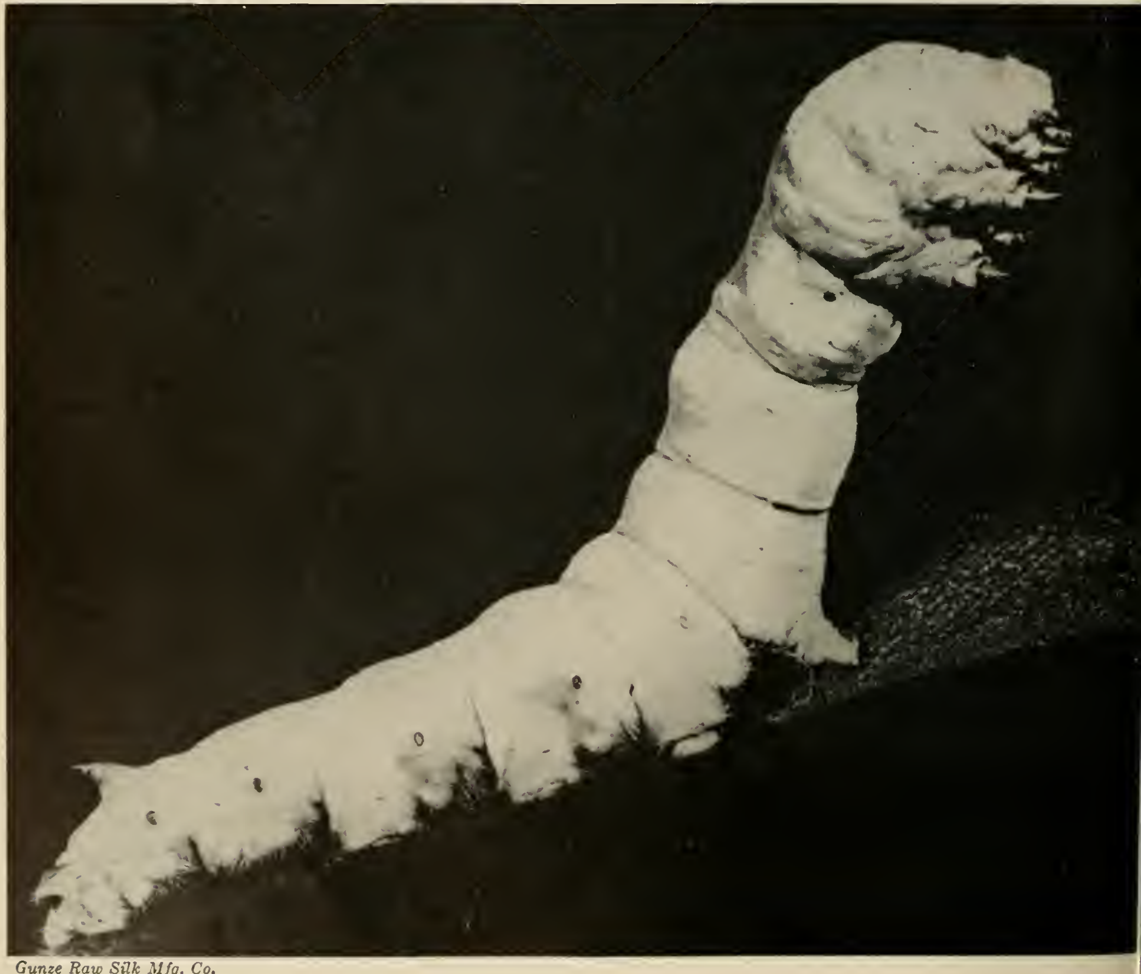
The care and labor of the people who handle the growing insect furnish the most interesting human touch of the whole business. Members of the family often incubate the eggs by carrying the egg-cards inside their clothing, and when the newly hatched "ants" arrive, the entire home is given over to their care. It means a twenty-four-hour-a-day routine to feed them, and to clean the trays on which the mulberry leaves are sprinkled. Changes in heat and cold, mois-



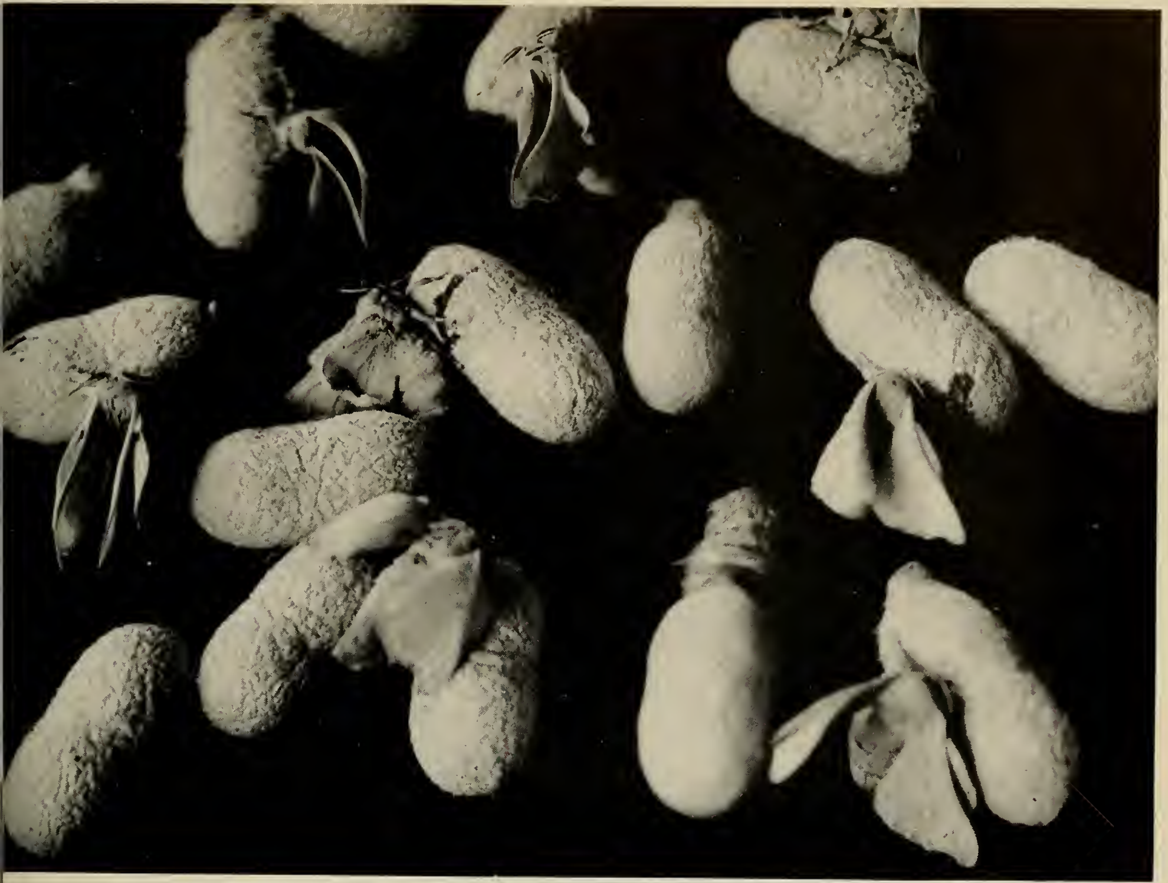
In scientific breeding, the female moths lay their eggs on cards that can be stored until the eggs are wanted for hatching. At the left are pictured typical storage frames

Morimura, Arai, and Co.

A full-grown silkworm magnified to about twice its actual length. It has finished feeding and is searching for something upon which to attach the first outer layers of its cocoon



Gunze Raw Silk Mfg. Co.



Morimura, Arai, and Co.

Certain moths are allowed to hatch from the cocoons in order to perpetuate their kind. The cocoons broken open by the emerging adult are unfit for reeling, but have other uses. Shown about actual size

Determining the sex of the insect in order to make possible proper breeding. This determination is made by weighing, the female being heavier

Morimura, Arai, and Co.

ture and dryness, affect the physique of the worm, the value of which depends wholly upon the nature and dimensions of its final secretion. In the model sericultural annexes of the major factories during the spring season, a continuous overlapping succession of stages of the caterpillar is nursed in rooms like hospital wards, so that the whole larval existence of about a month may be seen in adjoining rooms. The Dionne quintuplets in Canada scarcely have more careful attention than the young *Bombyx mori*, but it pays when the cocoons go to market, which happens as soon as they are spun and before the moth can spoil them by emerging.

The markets are on the order of auction sales, where the highest bidder takes the lot. The value of cocoons depends upon their size, shape, texture, and yield — the quantity of fresh cocoons required to produce a certain weight of raw silk. The farmers and their harvest pour into the market place by foot, rickshaw, pushcart, wheelbarrow, wagon, and motor truck, and the long care and labor of the industrious sericulturist have their financial reward.

HOW RAW SILK IS MADE

After the cocoons change hands they are rushed to huge drying ovens, where the living organism inside is killed, so that the cocoons can be stored until they are required by the reeler: the dehydration also reduces the possibility of damage by mildew. Throughout the world, there are many localities where filatures and drying ovens are not available, and where the farmers and their families reel their own thread. By immersion in very hot water, the insect inhabitants are killed within their shells and the natural gum which cements the texture of the protective envelope is softened, allowing the women to unwind the fibers through a guide on to a drum, revolved by hand or foot-pedal. The resulting skein is prepared for use in weaving, and raw silk, of a kind, is made.

This process of manufacture by the peasant women of Japan, China, Bulgaria, Italy or elsewhere, is essentially the same as that of the modern factory, but the quality of the product would find no market in the United States, where the increasingly strict standard of the American shopper has established a goal toward which all raw silk producing countries have reached, but which only Japan, China, and Italy have attained. The refinements of the process, by which the present commercial raw silk is made possible, are the story of the modern steam-operated filature.

The principles governing the modern reeling factory are the general formulæ of big business — efficiency, economy, mass-production, and especially supervision, and they become effective upon receipt of cocoons into the sorting room. Here they are examined, much as hens' eggs are candled, and separated according to color, size, shape, and texture. From the sorting room they go to the boiling apparatus, where an endless-chain system of wire cages carries them through a series of hot and cold baths, accurately timed to thoroughly soak the cocoon walls inside and outside, so that the gummy coating of the fibers is partly dissolved and the adhesion of the adjacent portions of fiber is lessened. This soaking does not injure the quality of the strand, if not carried to excess, because less than 1 per cent of gum is removed, leaving around the filaments a protective covering which is about 20 per cent of the total weight of the finished raw silk.

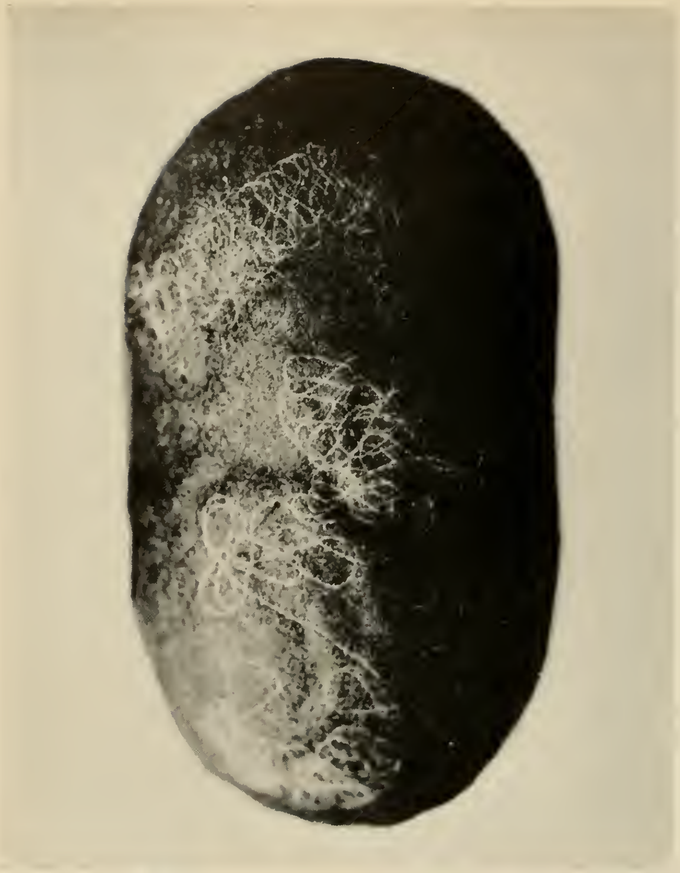
If eventually a laboratory test is made to determine the actual percentage of gum content, by boiling the raw silk in an olive oil soap solution until all gum is removed, the dual nature of the fiber is disclosed. When the worm spins its oval, the fluid from the silk sacs is expelled through two minute spinnerets close together in the lower jaw, and the liquid immediately congeals into two parallel filaments, technically called fibroin, cemented together and covered by the glue, called sericin. The sericin is an indispensable protection for the filament during all the reeling and subsequent manufacturing operations.

When the reeling girls receive the cocoons, big business temporarily relinquishes control into the hands of each individual woman, whose highly developed sense of sight and touch and timing are responsible for the poor, good, or superior quality of the skein she creates. Upon the skill of each girl

To Market

Morimura, Arai, and Co.

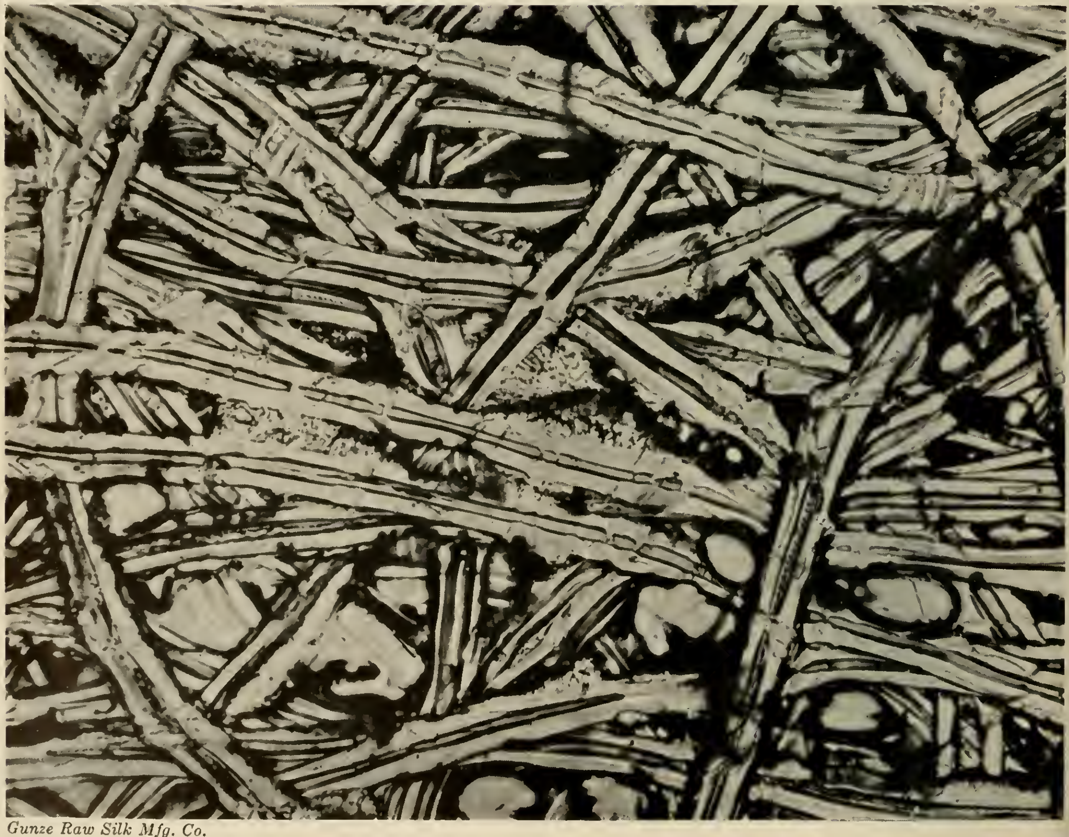
The cocoons are rushed by the farmers to various cocoon markets where their crops are turned into cash. Speed in transit is essential, for there is always danger of the moths emerging en route. Above, coolies are shown arriving at a Japanese market. Inside the building an auction sale is in progress. This method of cocoon trading is typical of Japan and China



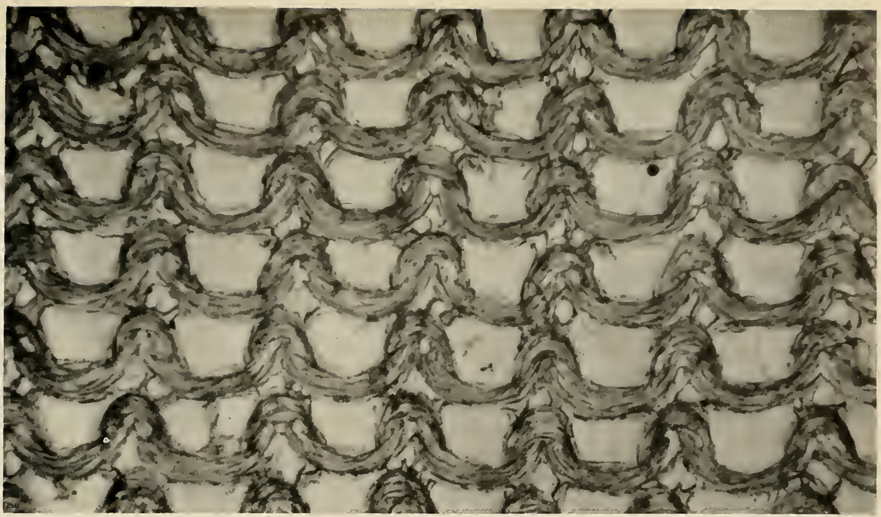
A newly started cocoon with a thin wall showing the method used by the worm in secreting the filament. The worm moves its head in a figure-eight motion, building up the walls in a succession of similar designs, as may be seen in the light lines in the photograph. The cocoon illustrated is enlarged about four times

Gunze Raw Silk Mfg. Co.

A photomicrograph of the surface of a cocoon. It shows how the secretion of the silk worm is composed of two filaments of fibroin surrounded and connected by a gummy substance called sericin

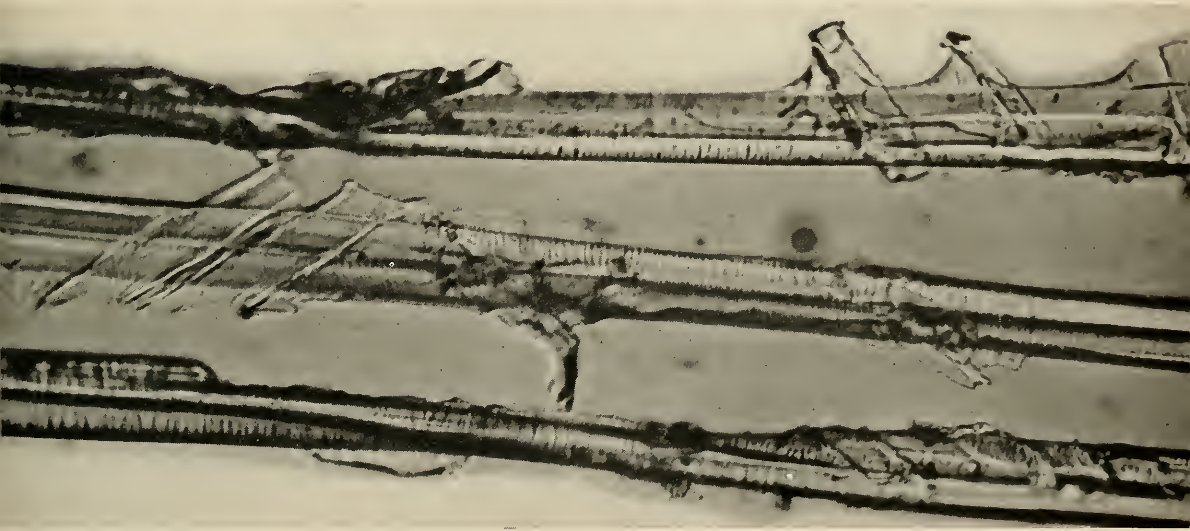


Gunze Raw Silk Mfg. Co.



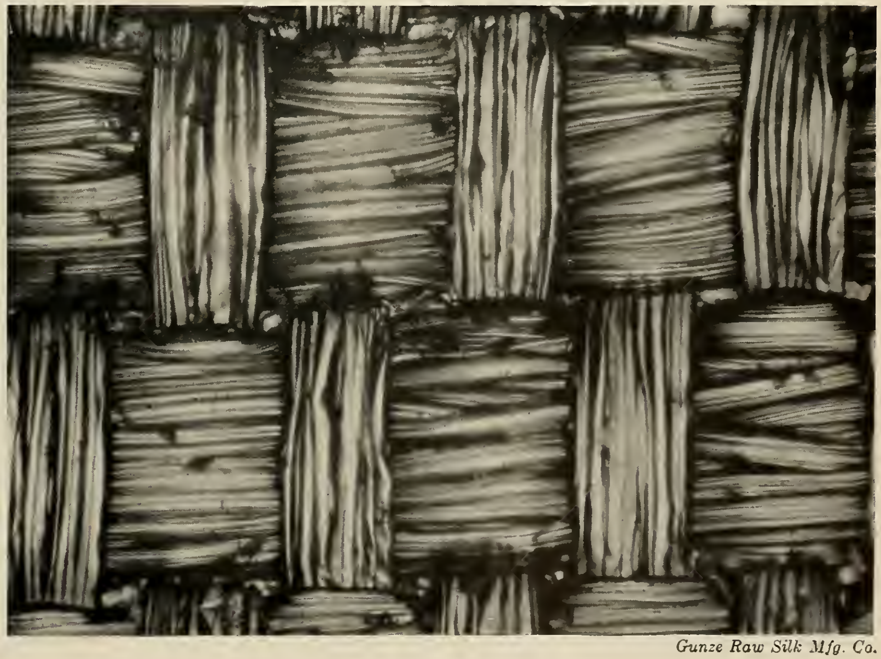
A photomicrograph of silk hosiery fabric, showing the loops formed in knitting

Gunze Raw Silk Mfg. Co.



unze Raw Silk Mfg. Co.

(Above) A photomicrograph of stretched cocoon filaments, showing irregular portions of the gum which contribute toward making irregularities in the diameter of a silk thread



A photomicrograph of a piece of woven silk fabric

Gunze Raw Silk Mfg. Co.

depends to a large extent the reputation of the mill, and the selling price of its product.

Students of sociology and economics would be much impressed with the problem of reproducing in America the conditions surrounding this industry in the Far East. If it were merely a question of plant efficiency or the development of machinery to do away with hand labor, the reeling business would long ago have become a subsidiary in the United States, of fabric mills. However, the students would recognize the interesting fact that raw silk is not essentially a machine-made, but a handmade article, and that the so-called reeling "machines" are really only tools in the hands of more or less skilled workers, and that the value of the thread depends largely upon the manipulation of many cocoons soaking in a basin of hot water. These highly capable women work more hours a day than any American laborer, even before N.R.A., and are paid about ½Yen a day (with the Japanese Yen currently worth 28½¢ U. S. money) plus board and lodging, with very infrequent holidays. Yet the result of their labor is the most important export ol Japan and China, and the basis of our most beautiful fabrics.

REELING

The work of the reeling girls consists in uniting the end of four or more cocoon fibers into a continuous thread of a comparatively uniform diameter This thread is attached to the circumference of a rapidly revolving drum which pulls the fibers vertically away from the reeler at the rate of several hundred yards a minute. Since the usable length of fiber on a cocoon is between four and seven hundred yards long, it is constantly necessary to add more fibers to maintain the running length of the thread. With the free, outside ends of the cocoon in one hand, the girl throws end after end with the other hand on to the moving thread, and it sticks and lays parallel by means of the wet, gummy sericin. As each strand joins the running thread, its cocoon bobs about in the basin, held down only by the weight of the water it contains, and if the gum is insufficiently softened to permit absolutely smooth removal of every portion of the cocoon wall, the cocoon jumps after its end until it is stopped by a porcelain eye through which the thread passes. The combined fibers are given cohesion, and some of the water is squeezed out of them, by twisting the thread back on itself in a spiral contact several inches long. From there it goes on to the drum, and the product would be essentially raw silk, lacking refinements.

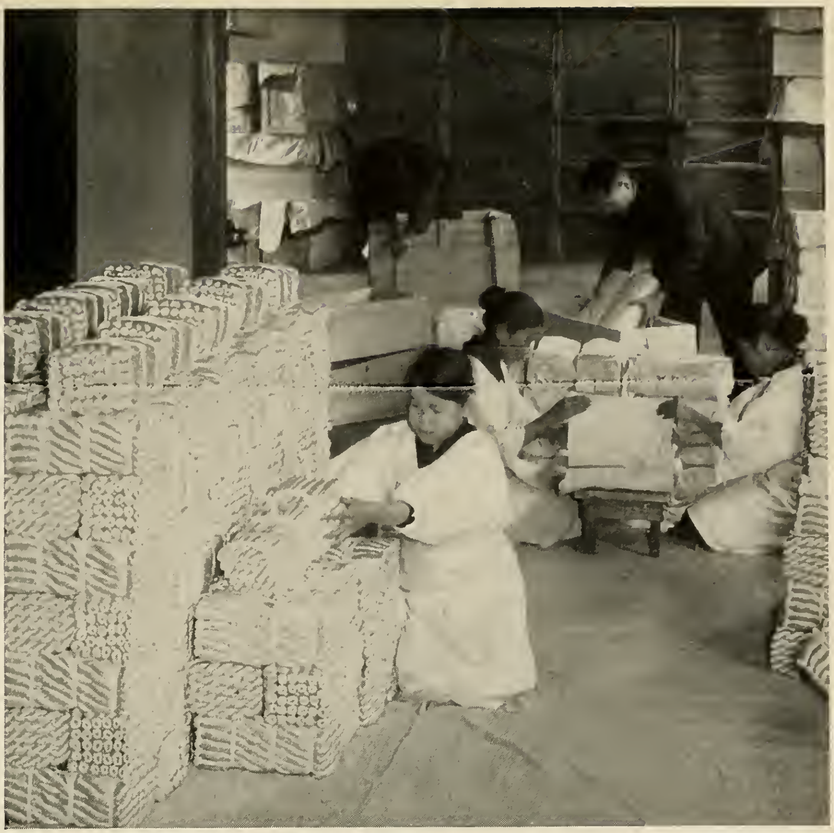
THE NECESSITY FOR CARE

However, raw silk without refinements has no market in the United States, which buys 75 per cent of all the world's exportable supply. It is in her ability to improve the quality of her running thread that the reeling girl demonstrates her importance in the process of making a thread uniform enough to be used in the severest requirements, such as sheer hosiery. In reeling, the girl attempts first to maintain in the running thread an unvarying number of cocoon fibers, each of the same diameter. This is really impossible, because every fiber changes its individual diameter throughout its length, being thin at the start and finish, and thicker in the center of its length, so that the reeler must not merely add cocoon ends in a mechanical manner, but must cast them on in a way to avoid the joining of all heavy or all thin portions, and must glue together, for instance, two heavy and three thin portions of cocoon fiber. Besides watching this evening-up process, the operator must produce a thread with a circumference as nearly smooth, like a glass rod, as possible.

In short, the girl must reel a thread with the maximum degree of uniformity, regularity, strength, elasticity, and ability to be easily worked in the American mills. The degree of perfection which she attains, combined with some difference in the quality of cocoons employed, makes this raw silk worth as little as $1.35 or as much as $2.75 a pound.

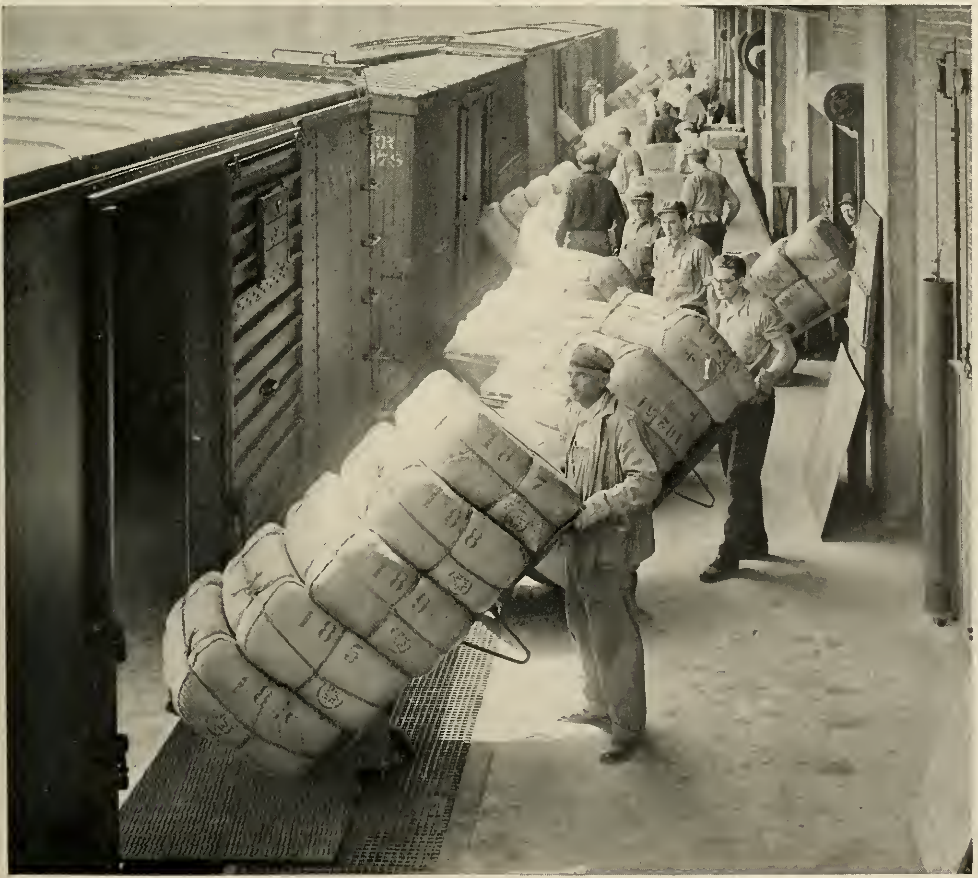
Many attempts have been made to use mechanical devices for joining the cocoon ends into a thread, but no device has yet been perfected that will consistently produce a quality as good as the girls can make, at as low a price. Until such a machine should be evolved — and it seems improb-

A packing room in a filature. Here the tightly twisted skeins are shown tied into "books" ready for baling and shipping from Japan to other countries

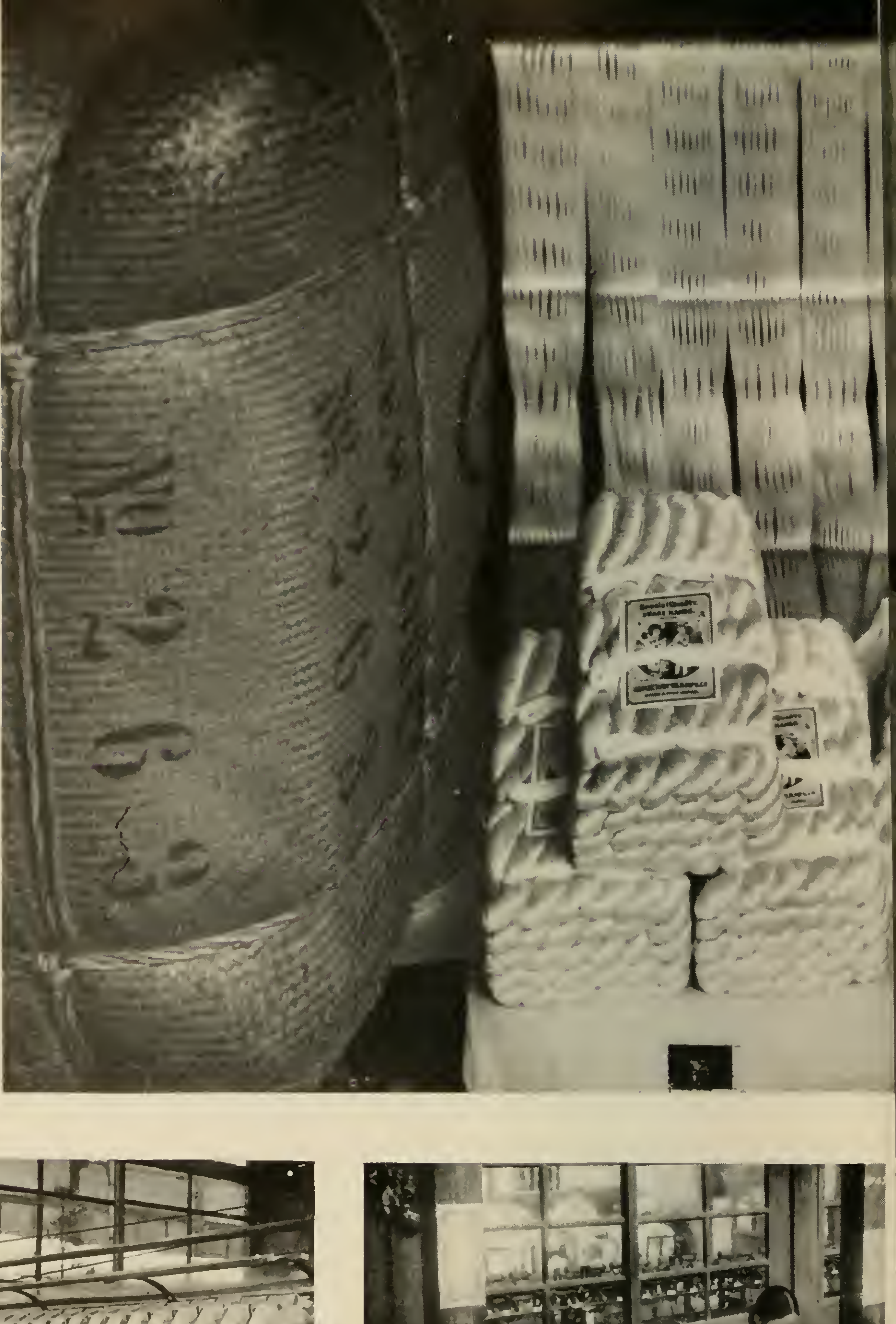


Photographs from National Federation of Textiles

Bales of raw silk after arriving in the United States. At present raw silk from all the principal exporting countries is received in much the same condition

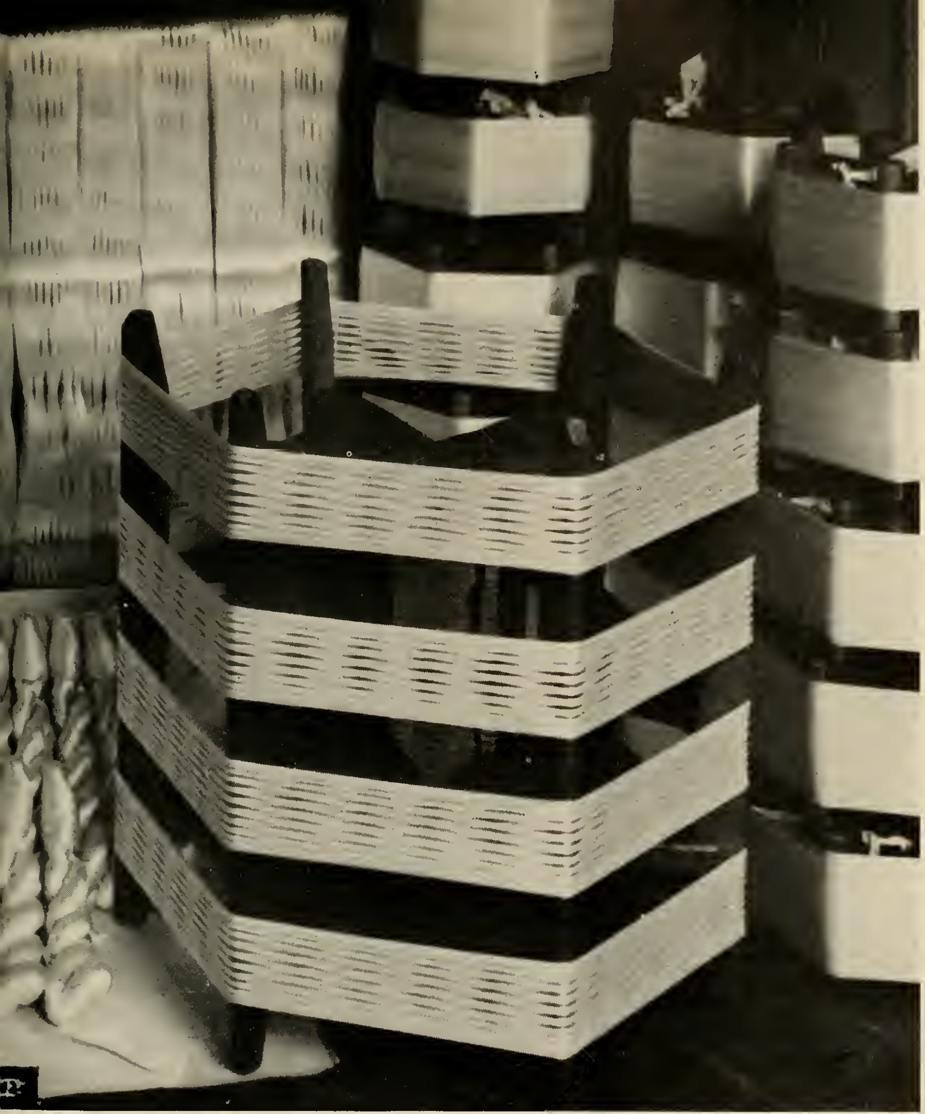


The four pictures below from left to right show (1) A modern reeling machine with one girl making twenty skeins; (2) The process of twisting the skeins tightly to conserve space in packing; (3) Operator in an American mill, uniting several strands of raw silk into multiple thread yarn for use in weaving cloth; (4) Weaving yarn into silk cloth



Gunze Raw Silk Mfg. Co.

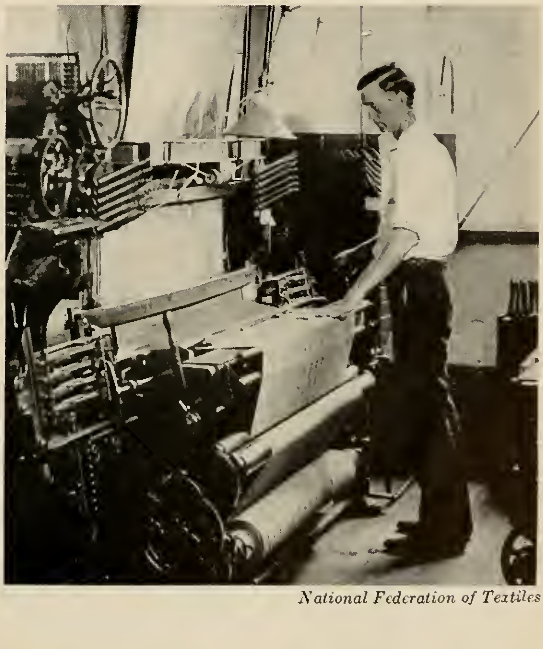
Morimura, Arai, and Co.



The large photograph shows the steps in preparing the silk for shipping after it has been reeled. From right to left the silk is shown on drums, from which it is wound on to six-armed reels, then laced, twisted, tied in bundles, packed into cotton bags, and protected by straw matting

Gunze Raw Silk Mfg. Co.

Cheney Bros.



National Federation of Textiles

able — the important commercial production of raw silk will remain in the skillful hands of the women of the Far East.

After the combined fibers are reeled around the drum, they are rereeled on to another frame, into skeins of a fairly uniform weight, then tied, inspected, twisted, and packed into bundles called "books," and then into bales of about 133 pounds, for shipment abroad. To fill rush orders, the bales are unloaded directly from the ship's hold into waiting express trains on the docks of the Pacific coast ports, and speeded without stop to New York, for distribution to American manufacturers of yarns and fabrics.

THE USES OF SILK

It is interesting to realize that this material called "raw" silk, because it is the raw material entering into the manufacture of numerous yarns and fabrics, is in reality a "finished' product, the result of long, skillful, and expensive preparation and labor in the countries of origin.

The greatest part of all the raw silk imported into this country is converted by our manufacturers into multiple-thread yarns with from two to twenty ends, twisted together by three to seventy turns per inch. This processing gives the delicate cocoon strands sufficient strength to resist the action of high speed looms and knitting machines, and also imparts the crêpy appearance so characteristic of certain fabrics.

In the knitting of women's full-fashioned hosiery, the greatest reliance is placed on the ability of the filature to reel raw silk of the most superior quality, for the manufacturer of hosiery knows how carefully his stockings are examined by the women who buy them.

Other familiar uses of silk are: women's dresses, hats, lingerie, shoes, gloves, sweaters, and bathing suits; men's suits, pyjamas, neckties, shirts, and scarfs; home furnishings like curtains, rugs, comfortables, lamp shades, sheets and pillow cases, tablecloths and napkins, and upholstery.

Additional less familiar articles in which silk is employed are: Mohammedan prayer rugs, church vestments, football pants, fishlines and flies, tennis racket strings, insulation for wire, waterproof tobacco pouches, oiled silk raincoats. Also, silk enters into military use for cartridge box cloth, balloons, dirigibles, and parachutes. Commercial articles are bolting cloth for sifting flour, typewriter ribbons, tents, dental floss, and violin strings. Doctors use silk thread for stitching surgical wounds and for artificial ligaments.

Much could be mentioned regarding the strength and durability of the product of the little caterpillar, in contrast with its fineness of diameter. Iron wire has a tensile strength of 90,000 pounds per square inch; that of silk is 64,000. The size of raw silk used in hosiery knitting is so fine that there are 319,000 yards to the pound, and the exportable bales from Japan only, in 1933, contained about 19,421,325,000,000 yards of raw silk of various sizes.

This same 1933 Japanese export of about 73,000,000 pounds, was the result of the life work of some 220,000,000,000 worms, about 3000 cocoons being required to make a pound of raw silk. The worm which spun the cocoon ate fifty times its own weight in mulberry leaves. These leaves were grown, and worms raised on them, by more than 2,000,000 families in Japan alone, providing employment for an additional 100,000 mill workers.

THE ECONOMICS OF SILK

These statistics will indicate the economic importance of the silk industry to Japan, and it occupies a strategic position also in the balance of trade of China, Italy, and the United States. Our country buys 85 per cent of its total consumption of raw silk from Japan, and in return sells to that country huge baleage of American cotton, worth even more than the silk, which, however, provides most of the money to pay for the cotton.

From international balances to individual preferences, silk plays an important part in the lives of all of us, and it is hoped that the story of silk may impart a new interest to the users and wearers of the Queen of Fabrics.

The Elk of Jackson Hole

An evaluation of the problem brought about by the increasing herds of elk on the limited ranges that have been set aside for them

By Olaus J. Murie
Bureau of Biological Survey,
U. S. Department of Agriculture

As THE 1934 hunting season opened in Jackson Hole, Wyoming, great concern was expressed by many people over the elk situation, particularly because a portion of the Teton State Game Preserve, for many years kept an inviolate sanctuary, was this year opened to hunting. The gist of opinion, both local and elsewhere, appeared to be that the elk were getting "a dirty deal."

At the risk of adding unduly to the already voluminous literature on the elk, I should like to discuss them once more and state frankly my impressions of the present situation.

First, why do we want the elk? Why all this furor over an animal? Is our interest selfish? Commercial? Altruistic? It may be worth while to examine our motives, for they underlie our actions. I should like to review our various viewpoints, how different ones of us make use of wildlife, and enjoy wildlife. To do so, and before discussing the present hunting season, let me go back and relate some personal experiences.

One day in July I had climbed to the summit of a high, bare ridge, and sat down on a prominent point to rest and to sweep the landscape with my glasses. Below me, in rolling undulations, stretched the forest, with numerous open parks. At one side the ribbon of Pacific Creek wound its way toward the valley, the upper Jackson Hole, the distant parts dimmed in the haze of a quiet summer day. And before me, emerging from the mist of the valley, rose the Tetons.

At first there was little sign of active life. A Clark's nutcracker flew by me with strident wing beats, high over the tree tops, and disappeared in a grove of white-barked pine. There was a clatter of pebbles as a fat marmot scrambled up the slope near by, then squatted in the entrance to his rocky den and looked over the world with infinite patience.

Then a movement in a green meadow just below me caught my eye, and I stiffened to alert attention as an elk came out of the shadow of a pine and began grazing. I caught other small movements, then discerned other shapes obscured in the shadow of the forest edge, and to my amazement I became aware of a whole herd of elk resting in the shade. They were mostly cows and calves, although I made out the outlines of a spike bull, with velvet antlers, in among the trees. It was the season of plenty and the animals lay about in green vegetation in all attitudes of relaxation and comfort.

Another cow arose and slowly wandered out in the meadow, where she picked daintily at the grass. Presently several more joined her, until the meadow was dotted with feeding elk. A calf, getting into the spirit of the occasion, trotted up to its mother and nudging her boisterously, readily found the well-known fountain of good things for calves, while its mother nonchalantly went on chewing. Soon the lazy animals began to lie down again, the calves almost disappearing in the tall grass.

It was a satisfying picture, a green wilderness meadow, dotted with sleek, red-coated elk, oblivious of danger, only concerned with their utter well-being in the season of plenty. A bright spot in the memories of the wilderness traveler.

I could mention numerous such occasions, the bright side of elk life, and incidentally a high type of human enjoyment of wildlife.

The winter presents another aspect. But lest we get the notion that winter is all hardship, let me refer to another incident.

One of the greatest thrills for a visitor to the high summer range of Jackson Hole is to come upon a big bull elk in his proper environment

(Left) The baby elk huddles close to the ground and remains motionless when its mother leaves it in order to find food

(Below) During the season of abundant food, the bull elk grows his mighty antlers. During this time they are covered with fur that is known as velvet

Bureau of Biological Survey

After the antlers of the bull are hard, early in the fall, the animals indulge in playful sparring, which is preliminary to the more serious contests that take place during the mating season

(Below) The summer range of the elk is a glorious succession of forested ridges and valleys interspersed with mountain meadows

Bureau of Biological Survey

I was snowshoeing in the foothills of southern Jackson Hole, tracking a coyote to see what it had been up to during the night. On one slope I found an exciting snow record of its chase of a jack rabbit, the long leaps, the desperate dodging of the quarry, the violent turmoil of bloody snow, then the long, orderly line of coyote tracks, with an occasional red spot in the snow.

FOOD BENEATH THE SNOW

Topping a rise, I came suddenly in view of a group of elk on another slope before me. Some were feeding, but most of them were lying down in a picturesque clump of aspens. The entire hillside was pitted with the elk diggings, where, as I later found, they had pawed down through the snow to a depth of at least thirty inches. Here they must dig for every mouthful, a miserable existence, one would think. Yet this, too, was a picture of contentment. Possibly the elk were not fully aware of the beauty of the winter landscape, the delicate tracery of aspen shadows on the snow, the ghostlike, snowy Tetons across the valley, but certainly they were a part of this picture of well-being. It was not an occasion of misery. One must judge the situation from the standpoint of elk hardihood and ability and ecological fitness. The elk did not mind digging for their dinner provided the dinner was there, under the snow, and had not previously been grazed off or cut for hay.

Yet another incident. It was nearing the end of the hunting season, about the middle of November as I recall it. Two of my friends had waited until that time to go elk hunting, with the idea that the colder weather would insure keeping the meat in good condition. I was invited to go along, and as I could combine the task of supplying the larder with the opportunity of obtaining a specimen for study, I went. As there were many hunters in the field, I was urged to appear at the ranch home of one of my friends at some outlandish hour before daylight in order that we might have a chance. I do not recall just what the alarm clock complication was, but when I arrived at the ranch all was dark and silent; but my saddle horse was there, tied to the fence, all saddled and ready to go, a mute invitation, "Go and hunt if you wish, we couldn't wait and lose our last chance for an elk this year."

I got on the horse, and went, heading for the murky foothills showing in the darkness. A fine snow was falling. Presently the gray light of dawn pervaded the snowy atmosphere, and I could see horse tracks in the road I was following. As I entered the rolling hills, I saw more tracks. I passed a tent or two, where hunters were busy at breakfast — someone rising even later than I. By this time there were many tracks — evidently many others realized that only two more days of the elk season remained.

It was daylight by now, with intermittent flurries of snow. Two horse tracks led off across an opening in the woods, and I followed, idly wondering if my friends had gone there.

As I worked my way through the woods, seeking the open meadows, I had glimpses of elk, shadowy shapes disappearing in the timber. Occasionally I heard distant shooting. I came out on an open knoll and spied two horsemen below me, wearing flaming red caps. Just to pass the time of day, I turned in their direction, and as I came nearer I recognized my two friends, who stared in surprise at seeing me.

It is not my purpose to describe the details of the hunt, least of all the dying struggles of the elk. We did get elk, after a delightful roaming over snowy hills and through pine woods and aspens. We had fleeting glimpses of brown bodies through the trees, heard calves squealing in the distance. Then, on the top of a wooded hill, we came on a band of them. One of my companions left us to follow doggedly the trail of a wounded animal, which took him the rest of the day, while the other two of us fastened ropes to the necks of the elk we had shot. With a half hitch over the muzzle, and with a loop at the other end thrown over the saddle horn, we "snaked" them out over the snow, all the way down into the valley.

I wish to point out that the killing of the elk did not measure our enjoyment of the hunt. We were after elk, to be sure, and wanted to get them — meat hunters, if you please. But none of us get a thrill from shooting game, it is too easy. Our enjoy-

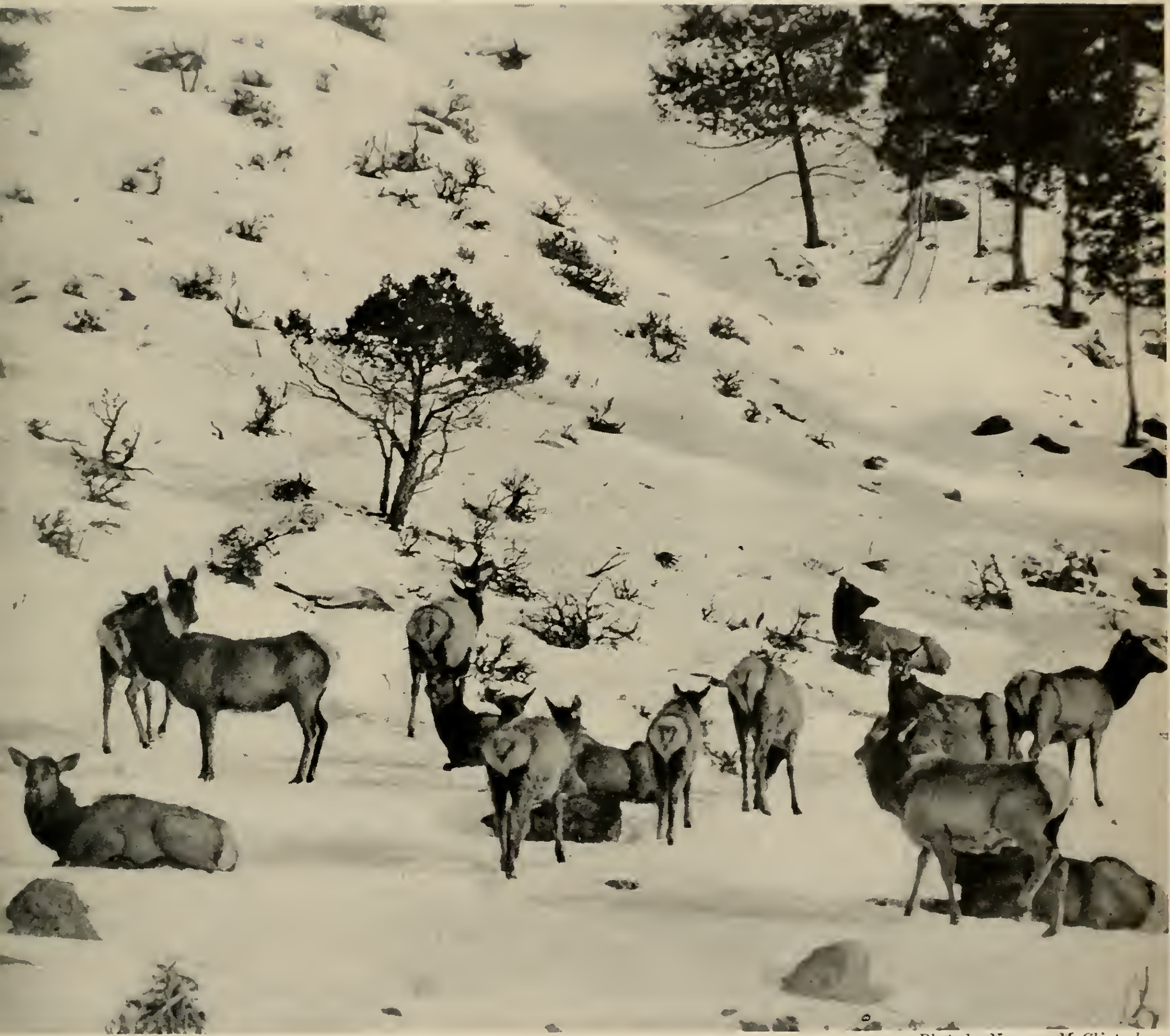


Photo by Norman McClintock

A Band of Elk in Winter

After the snows have come, the elk gather in large bands, and usually settle down for the winter in a rather restricted range. As the season advances, the bulls shed their antlers ment of this hunt consisted of the exhilarating sting of flying snow, the slow flush of dawn, snowy woods, the creak of saddle leather, glimpses of fleeing elk, something of the excitement of seeking, of *wanting* a wild animal. In short, we enjoyed a little of the flavor of *wilderness*.

Space does not permit recounting the numerous experiences with elk that are enjoyed in the Jackson Hole country. Each summer eastern vacationists come into the valley, and some of these procure pack trains and wander into the mountains, enjoying the wilderness landscapes, the elk, moose, deer, and lesser wood folk, and the exquisite sense of seclusion and primitiveness. Naturalists come in to enjoy the fauna and the flora, which is still largely unmodified by artificial conditions. Local dude ranches send their guests into the mountains, and residents of Jackson Hole enjoy the various phases of the out-of-doors as opportunity and inclination permit.

In the fall the hunters come. In the earlier part of the season, chiefly, come the trophy hunters, who generally go back in the mountains for more or less extended camping trips. Later, when the weather is colder and when the elk come down and are more available, meat hunters are more numerous, although even then many hunters seek a trophy as well as the meat.

KILLING IN LARGE NUMBERS

During the fall of 1934 a special effort was made to effect a large kill of elk. With that end in view a portion of the Teton Game Preserve, that part lying east of Pacific Creek, where hunting of elk is easy and where they can be obtained before leaving their summer range, was opened to hunting. In view of the interest aroused over this action and the comment that has ensued, it may be worth while to enumerate some of the facts and their implications.

When the season opened, hunters flocked to the hunting grounds. Various hunting camps were established by outfitters, with guides available, some of these within easy reach of the highway. As the season advanced and the elk came lower, hunting could be done from a car, by driving to the vicinity of elk crossings. As the elk came south through the mountains along the east side of Jackson Hole, other areas became favorite hunting grounds.

Efficient checking stations where hunters are required to report their kill have been maintained by the Forest Service and State Game and Fish Commission on the various highways leading out of Jackson Hole. As this is being written the records of game reports have not been fully compiled, and the local kill must be estimated in any event. Preliminary figures, however, indicate that the total kill of elk in Jackson Hole will be well over 3000.

THE WEAKNESS OF THE SYSTEM

Many who have witnessed the progress of the hunt are dissatisfied. Some complain that the hunting was too easy. Along a certain stretch of country paralleling the highway along Buffalo Fork, it was reported that fifty or more elk carcasses were found, some entire, others with the hind quarters removed, or in various degrees of abandonment. And of course there were the usual number of cripples that escaped.

One observer told me, in disgust, that a hunter drove in with a moose permit, got his moose the same day, and either that night or next day was on his way. Another complained that 150 bull moose will have been taken out of this general area this year — too many, he thought, and these include some which have in the past delighted tourists along the highway. It is claimed that the hunting on the game preserve drove the elk from very favorable summer and fall range north of the Buffalo Fork, and hastened their migration southward to winter range which is already short because of the drought and which should have been saved until as late a date as possible. This was a possibility that I pointed out last winter when the opening of the preserve was discussed. Yet in all fairness it should be mentioned that this year there was an unusually early migration, or "shifting" of the elk, many appearing at low elevations even in the summer, possibly owing to the premature drying up of portions of the high summer ranges. This tendency toward an early migration may well be a factor in the partial abandonment of fall ranges coincident with the hunting. It is a situation, nevertheless, well worth considering in the future.

Apparently there has been comparatively little law violation. Some cow moose were shot, mistaken for elk, and some elk were shot illegally. The warden service is excellent and in game cases convictions are usually obtained. It is my opinion that poaching is no longer a major problem in Jackson Hole.

REDUCTION OF THE HERD

No doubt there have been abuses of the hunting privilege. Unethical practices probably have occurred. While some of the law violations have been in the nature of mistakes, inexcusable of course, but still mistakes, others almost certainly were vicious in character. Probably some mistakes have been made by the game authorities, although it is my opinion that in spite of certain mistakes, the hunting in recent years has been well handled. It is not my purpose to gloss over abuses. But if we view the situation in a broad way, and with an eye to the future, it takes on a different aspect. Let us examine some of the features.

It may be objected that we are killing too many elk this year. I do not fully agree with some of the estimates of the present number of elk in the herd. Some estimates seem too high as a basis for management plans. I prefer to rely chiefly on the organized counts made from time to time. But after all, in the present instance this matter seems unimportant. We have a large herd, whatever the number may be. Even if the herd were temporarily cut in half, it would not be serious in my opinion. Numbers can be controlled by controlling hunting, as the situation demands. We have had a series of drought years, and this summer even parts of the summer range became very dry, and the feed is short everywhere. Far better to reduce the herd temporarily, in whatever degree that may be attained in an orderly manner, than to injure the range further, and permit the suffering due to food shortage in the winter.

The meat hunter is often derided. He is only after *meat*, not after *sport*.

Let us examine this question for a moment. No doubt each hunter thinks he is getting sport in getting his elk, whether he be a hunter who spends much money and time on a lengthy pack trip, or one who merely steps out of his car to shoot his elk.

I was standing on a rocky ridge one day, taking motion pictures of a band of elk. They filed past me and disappeared down the slope. A moment later I heard a shot down below. Going over to a point, I looked down and saw a car on the road that wound up this narrow valley, and on the slope above the car a group of people, apparently a family, with several children, was busy dressing out an elk. Easy hunting, to be sure.

I must admit that a hunt from an automobile does not appeal to me as much as a long wilderness experience, and I believe we should strive for the highest type of hunting, weaving into the event all the esthetic elements we can achieve. Yet we have the practical matter of disposing of a given number of animals in a limited area. Most hunting areas today are limited, considering the number of hunters. It is useless to argue that we should so manage the areas that all hunters are forced to go into the back country with pack horses to hunt. In the first place, many times this is unfair to the man of moderate means. It means that he cannot hunt. Then, too, such a procedure would probably destroy the very thing we are striving for. A crowded wilderness is no longer a wilderness — it has magically vanished.

THE HUNTERS

After all, can we legislate or "manage" sportsmanship into the hunters? Impossible. Even the trophy hunter, who spends much money on a long trip, perhaps making it an excuse for an out-door debauch, may be infinitely less a sportsman than he who buys his local license and modestly drives out in his car to get his winter s meat.

After all, when local residents take some of the surplus game and use the meat, that is a legitimate use, and the meat becomes a local economic asset.

The values of wildlife have been stressed so much in recent years and have become so well known, that it seems trite even to men-

During the time when snow is on the ground, the problem of food becomes acute, especially since the encroachment of civilization upon the present range of the elk. Today the elk are unable to spread out over the flats which were included in their former territory, and perforce are congested in a comparatively small area. This is an unnatural condition and introduces the problem of artificial feeding

The elk become more or less indifferent to mankind and to human habitations during the winter, because of the necessity which has bottled them up in Jackson Hole. In this region snows begin early and last well into the spring, but the elk is well equipped by nature for a hard winter provided he can obtain food

Photo by Norman McClintock

Alarm

During the summer, the elk forget the winter's contact with man and are alert to any intrusion. If one elk discovers an enemy, the alarm is quickly conveyed to the whole band, which flees in a body

Photographs by Bureau of Biological Survey

Flight

tion them. The commercial value of wildlife no longer needs advertising. Indeed, in true American style, we may be overdoing it. In our zeal to capitalize on the financial values, we are in danger of killing the goose that lays the golden egg, by too much development and resulting destruction of primitive charm of sport. Aside from the financial aspect, the recreational values, from the human standpoint, which I consider the greatest of all, include such activities as hunting in the fall, wilderness camping summer and fall, the sport of outdoor photography, and observation by nature enthusiasts. Not the least of its values, by any means, are the scientific aspects. We should be willing to admit that we have not solved all problems of natural history in this generation, but should pass on to other generations an unimpaired field for study. Finally, and I think we are inclined to forget this important aspect, we have in the domineering human a trace of generosity toward wild creatures, a growing desire to save them *for their own sake*. From the purely human standpoint, this is admirable, and it deserves encouragement.

I have here been speaking of *wildlife*. After all, the elk are only an item in the larger, greater picture before us. I submit, that the elk, stripped of its environment, its associated flora and fauna, its wilderness, so to speak, has lost most of its value for us.

THE NEED

I have reserved for the last, when space is short, the most important problem confronting us. This is not how many elk shall we kill this year, but where can they live? Snows are piling up in the mountains. The elk are down once more, to find the foothills and valley devastated by drought, overgrazed, or with the vegetation harvested and stacked. Even the swamp could be partly harvested and grazed in the past dry summer. Only limited areas are left for elk grazing. The inevitable conflict with harassed ranchers has begun, and the overworked wardens are busy trying to adjust difficulties.

I shall depart from Jackson Hole for a moment, and take a countrywide viewpoint. As a matter of fact, Jackson Hole is in the lead in many respects. We have here become aware of the great value of primitiveness, the frontier. Thanks to the Forest Service, Teton National Forest has in the past been administered so as to preserve the wilderness to a great extent. State authorities and local sentiment have contributed their share toward this end. Nevertheless, we have our serious game-range problem. And it is a general problem throughout the country. What will we do about it?

THE REQUIREMENTS

From the standpoint of community welfare, recreation and hunting, if viewed only from the commercial angle, represent an industry involving millions of dollars annually. It probably ranks with any other local industry, in the majority of communities, or could be made to do so. It is no longer a minor by-product.

We used to feel, "Well, if there is any land left over, we'll let it be for the game." And we have set aside the rough, high country, which can't be used for anything else. Then we find a winter range problem.

Do we expect to carry this enormous national business without any investment whatever? How much *good* land have we given to wildlife? We give them the leavings, then wonder and worry over our game problems of malnutrition and diseases, and try to patch and fuss. Are we, after all, giving the elk a "dirty deal"?

We have public domain, we have submarginal lands. I think we have the opportunities. Also, I think we have a better understanding. We have already awakened to the needs of the waterfowl, and the Biological Survey is energetically pushing a hopeful program of marsh restoration and possibilities for our big game. The vital thing to remember is that our herbivores require lowland winter ranges, wilderness recreation requires a wilderness, and wilderness requires space.

The Dodo of Mauritius

For more than two hundred years the dodo has been extinct. Its story is essentially tragic, despite the humor its name so often seems to suggest

By Dorothy L. Edwards

THERE are numerous birds notable for their beauty, some are outstanding for their astuteness, but few can claim the ability to amuse as one of their most prominent qualities. In the latter classification, among birds existing today, the penguin perhaps ranks first. A possible rival for this honor, unfortunately, many years ago passed into the realm of "extinct birds," but its very name causes people to smile, and visitors looking at a museum representation of one seldom fail to derive vast amusement from it. This bird is the dodo.

Although the dodo is in itself amusing, its history is tragic. Before the year 1598 the dodo lived a peaceful existence in the forests of a small island off the west coast of Madagascar. A large, unwieldy, and flightless bird, it apparently had no natural enemies to fear, and the fact that it was slow of comprehension as well as of movement was no great detriment to its survival.

At the close of the Sixteenth Century the arrival of a Dutch sailing vessel at this virgin island was at once the first step in making the dodo known to the world and the first step in causing its eventual extinction. An expeditionary party under the leadership of Jacob Cornelius Van Neck coming upon the small island uninhabited by humans, took possession and named it Mauritius. The Dutch sailors were delighted with the abundance of wild life which made the procuring of food an easy matter. The dodo, looking fat and juicy, naturally fell a victim to the culinary scouts, who soon found it was possible to kill the heavy birds by the simple and primitive method of clubbing them over the head. However, the bird did not prove especially palatable to Van Neck's men. As long as succulent turtle doves were to be had in sufficient quantity, the dodo was not too popular for its own good.

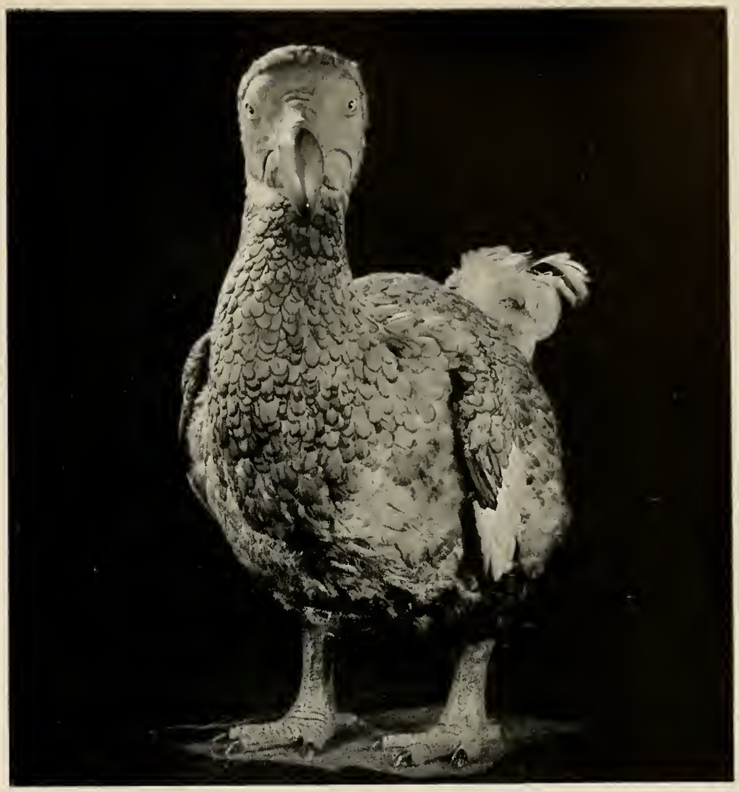
Several years after Van Neck's visit to Mauritius, another Dutch company stopped at the island, and again dodos were described as part of the native game. In 1602 a third visiting party reported finding the dodos and apparently mastered the art of cooking them more tastefully than did Van Neck's men, for at this point they were enthusiastically mentioned as food. Three or four birds furnished an ample meal for the whole crew.

Mauritius was colonized in 1644, and it was not long before the easily preyed upon dodo diminished drastically in number. Furthermore, the hogs, dogs, and cats that the newcomers imported found dodo eggs a tasty repast, and thus helped along the destruction. It is certain that well before 1700, less than a century after its discovery, the dodo of Mauritius had passed into extinction. Meanwhile the same fate had befallen two other species of dodo that had been found on neighboring islands.

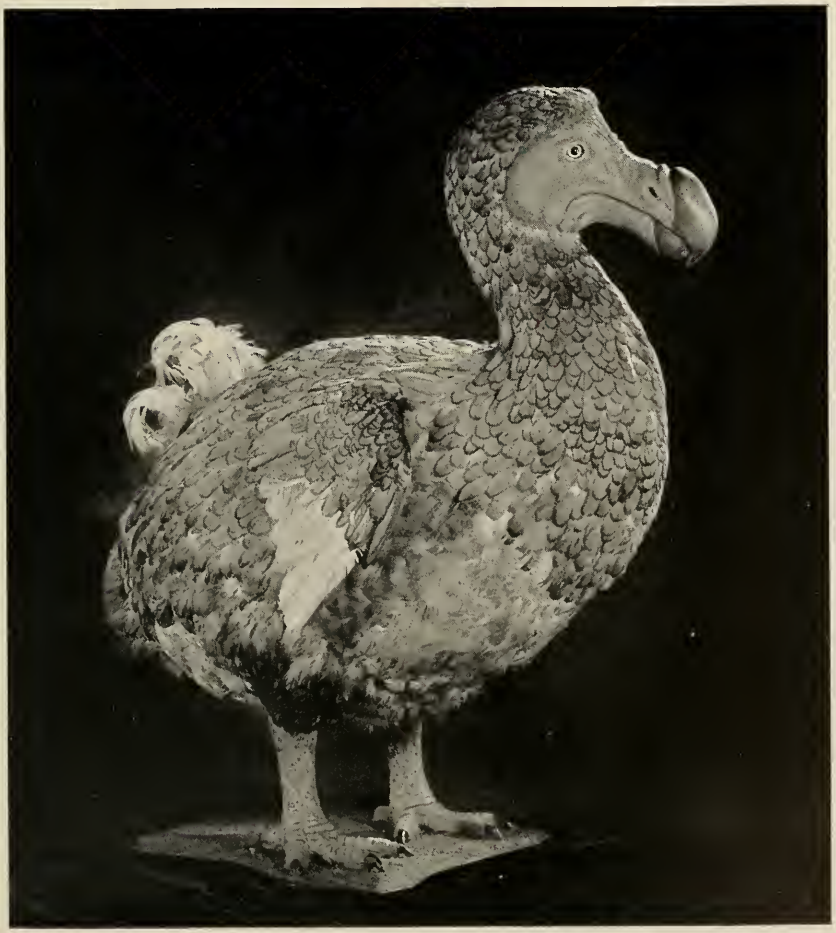
Fortunately a number of artists were inspired to portray the dodo both in drawing and in color, and from these pictures, together with written descriptions and skeletal remains, we have our present-day knowledge of the bird.

Even after its extinction the persecution of the ill-fated creature was not over. A stuffed specimen had found its way to the Ashmolean collection at Oxford. Some years ago the officials of the institution, in taking inventory, came across it, decided it looked shabby, and ordered it burned, saving only the head and right foot. This order was carried out — thus destroying the only complete dodo specimen in existence!

Since that time various reconstructions of dodos have been made. One of these, which was prepared in the taxidermy studios of Rowland Ward in London, was presented by Mr. Walter Winans to the American Museum of Natural History, where it may be seen today in the Flying Bird Hall, together with a restored skeleton. Sedately amusing, it stands on exhibit, apparently proud to keep alive the memory of its vanished kind.



A bird of another age, the dodo of Mauritius. This species (Didus ineptus) *had dark, ash-colored plumage, with a whitish breast and tail, and yellowish-white wings. Two other species* (Didus borbonicus *and* Pezophaps solitarius) *lived on neighboring islands, but all three became extinct at about the same time, more than two hundred years ago*



Below the Border

A naturalist's visit to the rugged country near Durango, Mexico, five hundred miles or so, as the airplane flies, west and south of Brownsville, Texas

By Alfred M. Bailey

Director, The Chicago Academy of Sciences

Photographs by the Author

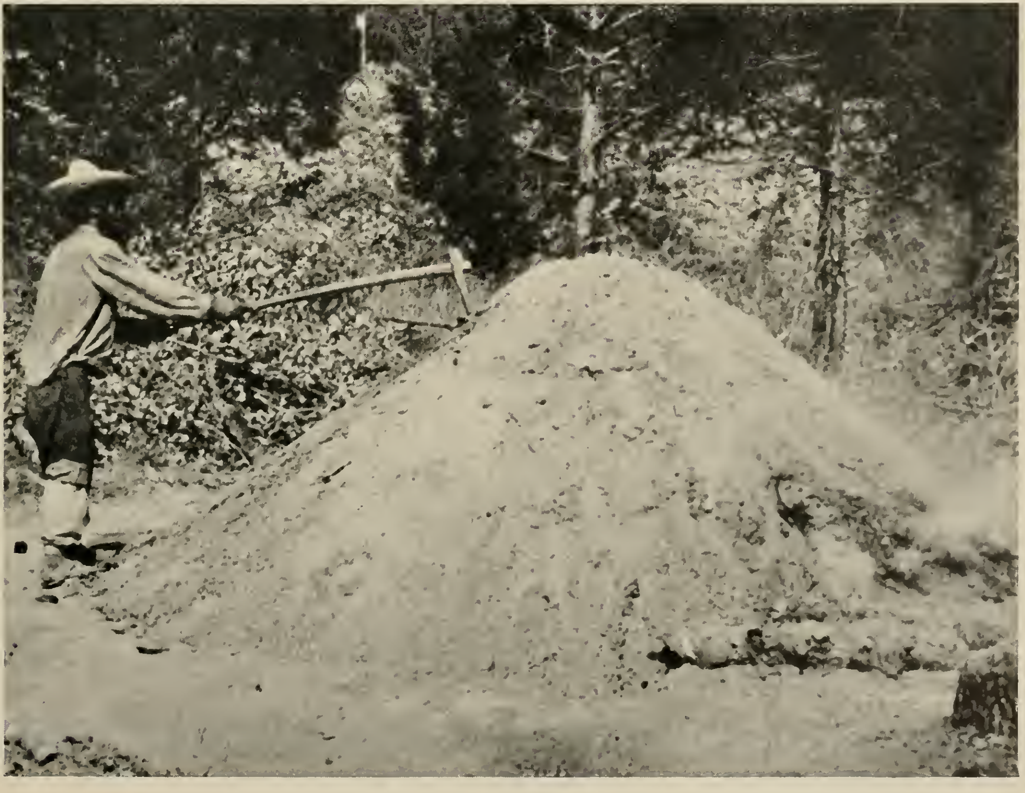
THE Rio Grande winding toward the Gulf has long been the dividing line between the attainable and the unattainable. The grass has always seemed greener, the mountains higher, and the people more interesting in that region beyond our border. Picturesque Mexican generals, doing and dying for no apparent reason, set their country apart from ours and emphasized the fact that theirs was a foreign land — a place of romance and adventure — but accomplished little toward making the region available to visitors. In years past many naturalists have combed the inaccessible places, it is true; they were hardy, experienced explorers, with time and ability to push to out-of-the-way spots. Now, however, it is possible for timid souls with less natural ability to make jaunts into primitive country and out again in a few weeks' time. Formerly it was necessary to keep close to the main routes of travel, unless well equipped for long overland journeys. but now, with the advent of sky trails cutting the blue, it is possible to visit almost any section in a few days.

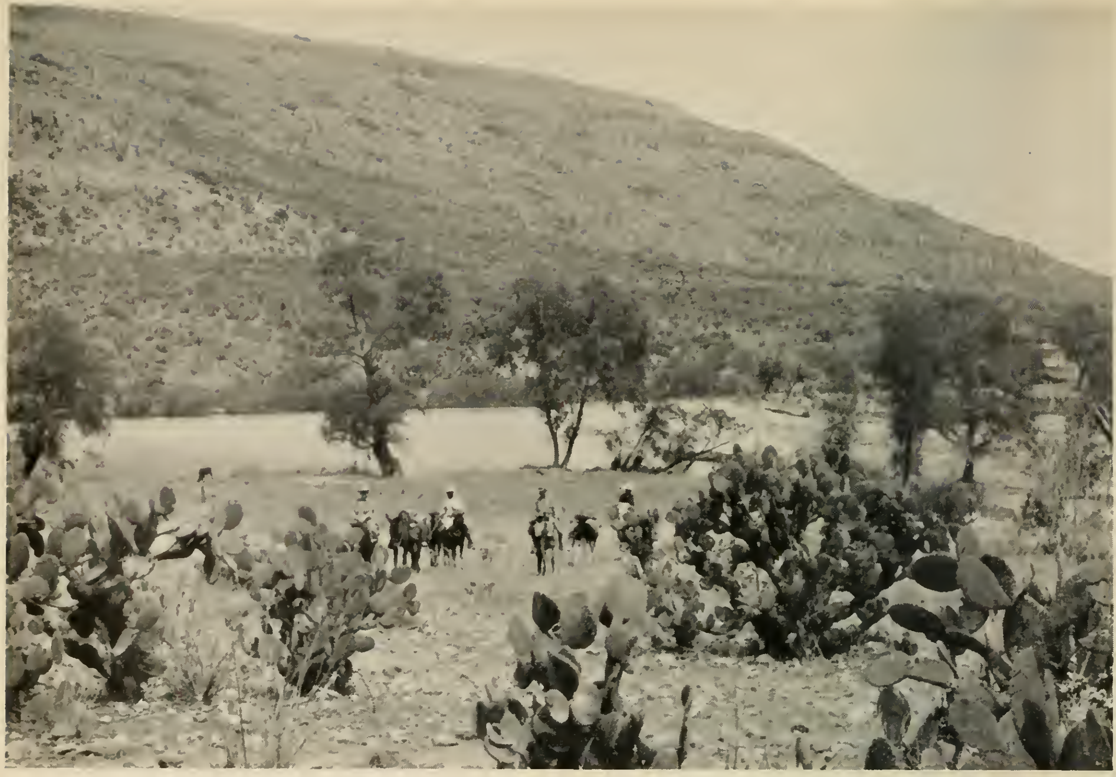
These routes, with planes flying on regular schedule, now offer quick transportation. I liked the enthusiasm of the agent of the Corporacion Aeronautica de Transportes at Brownsville, as we were looking over one of the little red Lockheeds, prior to the hop to the westward, for he was explaining the advantages of these trim flying ships over the larger ones used in the southern routes to Mexico City and southward. They made faster time, he said, could be landed in smaller fields, and as they were of light construction, in comparison with the heavier ships, would allow the passengers to break through the sides when the plane crashed, instead of their being caught in the wreckage and burned!

The planes leave Brownsville early in the morning, circle over the city, and then head to the southwest, high over the winding Rio Grande. The terrain is leveled by the height of the plane, and the thorny

Small dobe villages are scattered over the near-by treeless mesas, where the natives from the surrounding hills occasionally come with burro-loads of grain, charcoal, or wood, to barter for a few necessities of life

(Below) The making of charcoal is the major industry of the natives dwelling in the hill country. Small camps are scattered throughout the wooded regions where the natives secure suitable hardwood. Logs are cut to a convenient length and upended, and after the fire has been started, the core is covered with ashes to control the burning





(Above) Along the valley of the Rio Tunal are groves of the prickly tunal, cactus plants which assume treelike proportions. Near Durango the river flows placidly through rounded, sterile hills, but upstream the mountain-sides are precipitous, and the stream turbulent where it rushes between upright walls

(Left) The Rio San Juan has cut a deep valley through the mesa, and it was along these steep cliffs that Mr. Bailey found the Montezuma quail feeding upon fallen pine cones. Ravens and white-throated swifts cruised rapidly along the walls, while hawks of several species were encountered in the pines

The patient burro is the peon's best friend

(Right) The Rio Chico flows through sparsely wooded hills and joins the San Juan

(Below) The ancient caravan trail was cut by the hoofs of countless pack animals through a whitish stone which the natives called "caliche"

scrub trees which offer impenetrable barriers to one on foot, appear as velvet carpets, while roads are ribbons of brown meandering across the level surface. Monterey, with its smoking chimneys, is only a short flight, and then it is not long before one is headed over rugged ranges and wide open spaces clothed with cactus. The town of Torreon, one of the important cities of central Mexico, is a transfer point; the plane from the east arrives at the siesta hour when everything is closed but the "American Bar," so it is necessary to wait patiently for the plane to be overhauled.

We were bound for Durango, the capital of the mountainous state of the same name, where we expected to make a short trip afield into the picturesque canyon and pine forests.

DURANGO

The plane circled abruptly, skirting precipitous rugged ranges where ravens flew along the upright walls, and though they were headed in our direction, they appeared to be flying backward. From jagged crests which seemed within arm's reach, we passed over a level plateau where there were cultivated fields of great symmetry, and where the air became extremely bumpy. And then the gleaming city of Durango with its flat-topped houses and garden-grown patios came into view; the plane banked abruptly and pointed downward to a gentle landing.

What can be said of this Spanish city of 40,000 people, founded by Don Hernan Cortez some four centuries ago? Situated in the foothills at nearly 7000 feet altitude, it has a delightful climate. It is Old World in appearance, and has not had a rush of tourist traffic to spoil it for those who delight in out-of-the-way places. A beautiful old cathedral with mellow chimes overlooks the tree-grown plaza, where young people come to stroll when dusk settles over the hills, and music of old Spain, probably by radio from Mexico City, comes softly from one of the near-by buildings.

Durango was founded when rumor came to Cortez's receptive ear that in the northern reaches of Mexico was to be found a mountain of gold. What hardships must have been endured by the Spaniards as they trekked over the rough country, searching for the pot at the end of the rainbow — only to find a mountain of iron, which, so we were told, is one of the geological wonders of the world.

There are many old buildings to remind one of the early explorers, including an ancient old shrine upon a barren hill overlooking the city. For generations penitents climbed the steep slopes on hands and knees, kissing the ground as they progressed.

But our interests were in the wide open spaces. Mr. W. E. Brock and his kind wife offered their hospitality and arranged for our caravan animals. In a day's time we were afield astride mules, Mr. Brock, Boardman Conover, W. F. Ardis, and I, while a few pack animals in care of peons trailed behind. Ours was a combination pleasure and business jaunt; our excuse was to appraise a bit of timber, our purpose was to have a good time, and our course was up the Rio Tunal, a turbulent little stream which has cut deep gorges through solid rock. Vermilion flycatchers, perched in the bright sun, looked like gaudy flowers until they fluttered in the air to capture some swift-flying insect, and the rattling cry of small Texas kingfishers rang through the canyons. On the sterile slopes were masses of cacti and tall yucca-like growths ten or more feet in height with spikelike flowers, which seemed to be the favorite skulking places of curved-billed thrashers. We often heard the birds scolding in the depths of the tangle, where there was no chance of obtaining a glimpse of them.

SIERRA DE LOS CASTILLOS

At dusk we arrived at the junction of two streams — the Rio Chico which comes from the northwest, and the Rio San Juan from the south. We found our tents already in place, in charge of two Americans who had preceded us on the day before. Joe Green and Shorty Christiansen were a couple of punchers who had wandered south from the Rio Grande country, and were stranded. They had chosen a camp site near a large warm spring under tall cliffs of columnar formation, the picturesque escarpments being known, appropriately enough, as the Sierra de los Castillos.

It is not difficult to find excuses for lingering in such country. Montezuma quail, the clowns of the family, flushed from underfoot when we climbed along the high ridges, and surely it was justifiable to loiter, hoping to find what the birds were feeding upon. Flocks of thick-billed parrots flying overhead in wedge-shaped formation called to us, and beautiful jays hung about the camps of the charcoal burners, probably because they obtained an easy living there. There were few Indians in this region, and they were extremely poor, as most of them had lost their cattle and horses during the countless quarrels of various Mexican generals. Those we encountered were suspicious of us, and usually urged their horses along at a rapid trot, the women folks edging to the far side of the trail. In wide parks in the beautiful pine lands we occasionally jumped a deer, and turkey tracks showed that these fine birds were numerous, if we cared to take the trouble to hunt them. We did want a pair so that we might determine the race which inhabited that particular area; so one day we sent a camp follower ahead to secure them for us the following morning. We gave him instructions to shoot a male and a female, and to keep them in good condition.

THE VALLEY OF THE TURKEYS

We were on the trail shortly after sunrise. Following along the edge of an escarpment, we saw many birds of prey, including red-tailed, sparrow, and goshawks, and one Oaxaco horned owl. All were remarkably tame, probably because they were rarely molested. We finally descended into a broad valley known locally as *Bajia de los coconos* — "the valley of the turkeys," and we had not traveled far along the caravan trail before we encountered our hunter, the Indian, sitting on a rock, kicking his sandalled heels and grinning amiably, while alongside him, stretched out in the shadows, were two magnificent turkeys — both carefully plucked! Not even a tail feather remained to guide us in an identification.

We camped this particular evening in a clump of sad pine, their long needles drooping disconsolately, near a series of small springs. The water from these crystal pools ran in small rivulets and formed a marshy area which the natives called *Cienega Tableterro* — "the marsh of the board-cutter." Here we found a delightful spot to linger and enjoy our work of timber cruising, for there were many species of birds with which we were unfamiliar, and when we found ourselves puffing from steep climbs, we could always find an excuse to pause and watch some little stranger in a near-by tangle. But it was in the dead grass of our little marsh that we found what all naturalists seek — an undescribed race — and we were not even on a collecting trip.

A NEW GENUS

A half dozen small birds unknown to us were continually flying about, and Mr. Brock asked embarrassing questions concerning their identity, so in self-defense, we borrowed the cook's gun and collected one of each. In company with striped sparrows were several little dark finches somewhat like savannah sparrows, which, we found later, were not only unnamed but of a new genus. (Named by the late Outram Bangs — *Xenospiza baileyi* — *Proceedings of the New England Zoological Club.* Vol. xxii, pp. 85–88.)

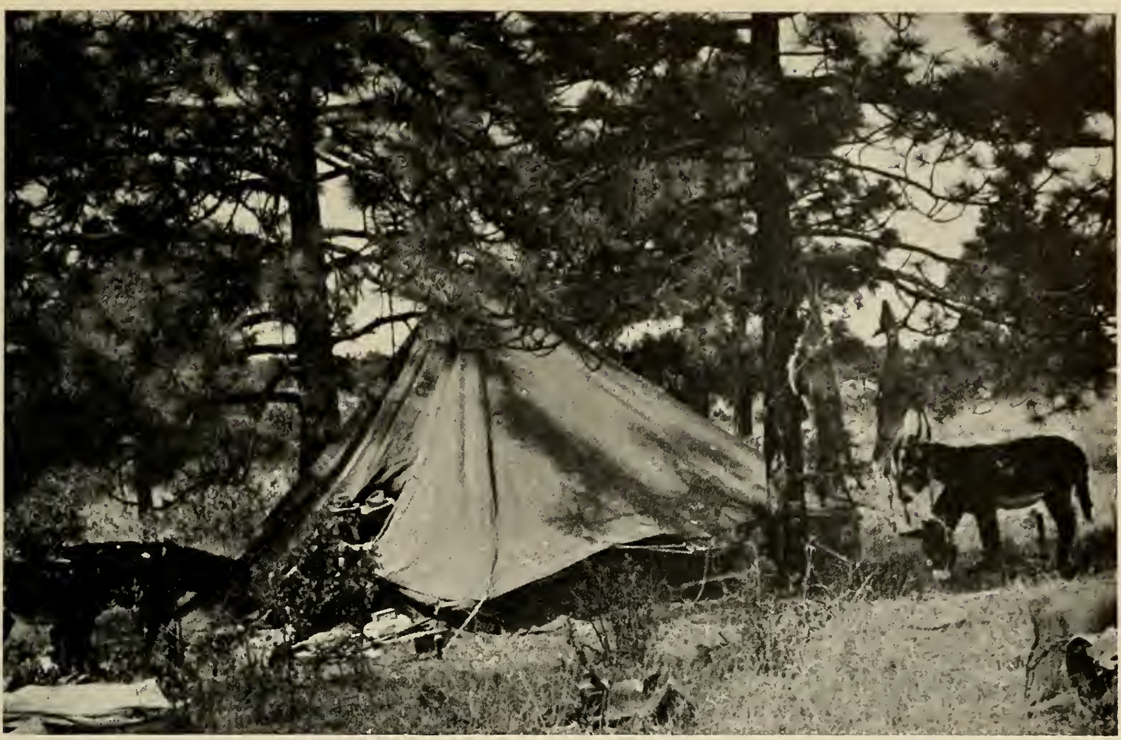
Days wandering in the hill country, feasting upon wild turkey and venison cannot last forever, so our course gradually led toward Durango. We skirted precipitous escarpments of the San Juan, where swifts darted along the crests, and then gradually dropped below the pine belt to a treeless plateau with great yuccas standing sentinel-like against the sky line. As we reached settled areas, the hillsides were clothed with groves of cacti and huge maguey plants. A small fruit grows on the former, and the native drink *pulque* is obtained from the latter. When the tall, flowering spike of this plant breaks into bloom, it is dug from the center of the plant, and sap forms in the cavity for a few days. This is non-intoxicating at first, and is known as *aqua de miel*, but when nature takes its course, a beverage of considerable potency results.

West of Durango towers the Sierra Madre, making a journey across country to the Pacific a matter of a week's caravan

A tousled-headed charcoal burner

(Left) Indians encountered along the trail were timid and uncommunicative, the women being exceedingly shy

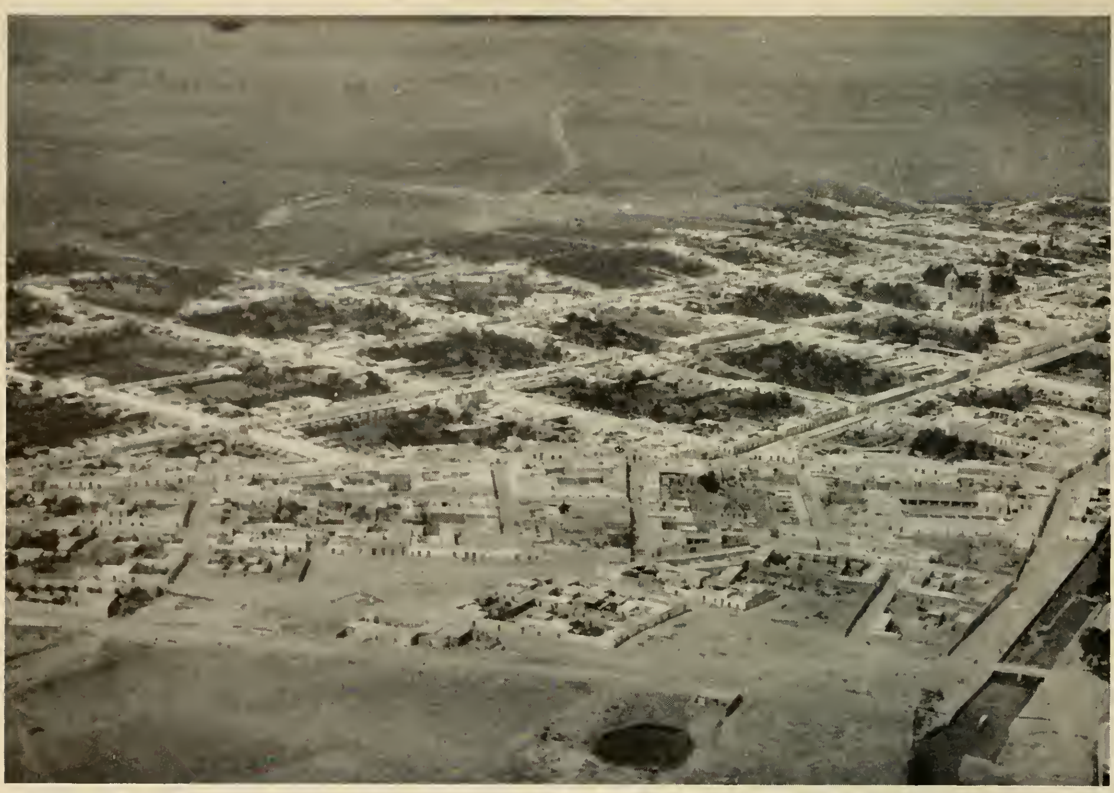
(Below) The camp followers gathered about their little fire where they prepared their meals. They were a jovial lot when by themselves, and passed the time telling stories of revolutions of an earlier day

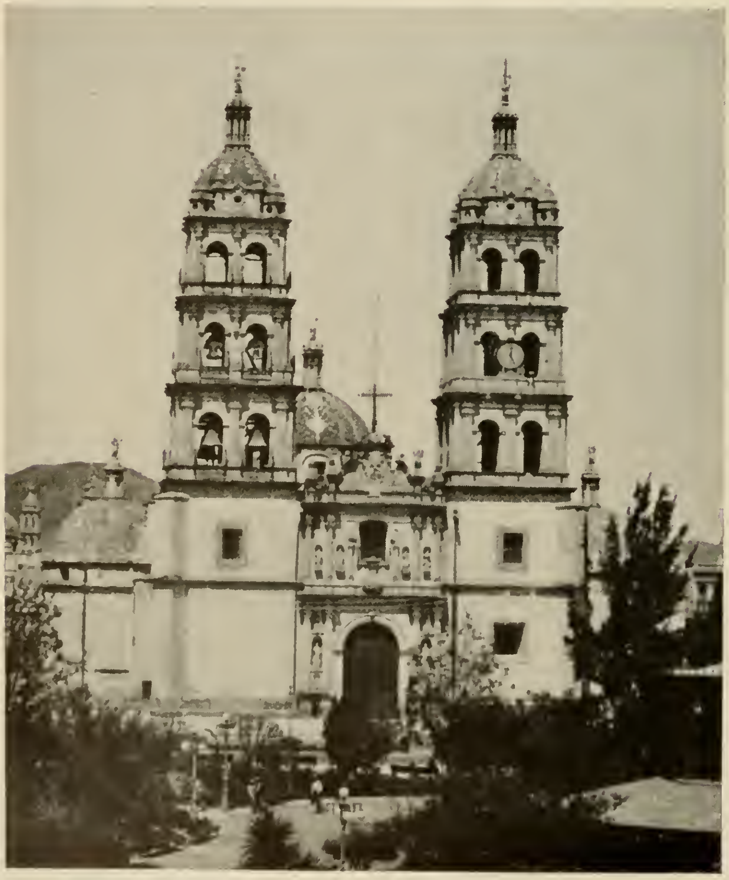


The tent usually was pitched amid a cluster of pines, where there was protection from the noonday sun. The inquisitive little burros seemed to enjoy human companionship, for they gathered near

(Right) The camp's turkey hunter was a picturesque fellow. He knew the ways of the wily turkey and had no difficulty in calling a band of birds within shooting range

(Below) Wide sombreros were worn by the natives of the hill country





Durango, the capital of the mountainous state of the same name, stretched below the plane, the whitewashed walls of the buildings gleaming in the light. As the plane circled low over the city, those aboard could see the wall-enclosed gardens, the ancient cathedral, and the Plaza and streets teeming with people

The old cathedral with its twin spires faces the Plaza, its mellow bells lending enchantment to the twilight hours. As dusk approaches, band concerts are given, and the people, young and old, promenade among the tropical plants trip over difficult trails. Our plans called for a short survey of Mazatlan on the Gulf of California, and so, instead of following routes which called for time and energy, we boarded a Lockheed at Durango late one evening and climbed rapidly into the west. The great tableland was cut by myriads of canyons which formed isolated flat-topped mesas; the canyons and the majority of the level areas were in dark shadow, with only an occasional rim rock still bathed in light. We crossed small camps, and saw a railroad winding far below. In half an hour we were well over the Sierra Madre, with great gorges and canyons below, while off to the south the ridges gradually faded away, their crests purple in the soft light. The Pacific was a band of silver below the clouds to the west as we reached 13,000 feet to clear the hills. Mists now hung over many of the canyons, and to the northwest the mountains were masses of shadow, the deep valleys being visible because the shadows were heavier. The sun gradually sank into the Pacific, blurred by small masses of crimson-tipped clouds. We lost altitude and gradually the shore line became visible in the fast fading rays. Then the lights of Mazatlan appeared as we circled lower and headed for a level area in the scrub growth about two miles away.

A TROPICAL COAST

The region bordering the Gulf of California is another world, just one hour's journey from the rugged country we had been working. Tropical birds of many species and varied hues are found in the thorny scrub which forms almost impenetrable tangles, while out over the water were many sea fowl cruising about in search of food. The naturalist has no difficulty in finding things of interest in almost any region, but the country near Mazatlan proved to have a wealth of material from which to choose. The town is well worth visiting; it is a tropical city with Old World architecture. The market place was filled with products of the field and animals of the farms and sea. Parrots and paraquets screamed from cages and merchants squabbled over prospective sales.

A CONFISCATED CAMERA

We lingered in this hospitable region as long as we dared. Conover found it necessary to investigate one area; Ardis another; while Brock frankly admitted his work was finished but that there was no hurry about going home. However, planes are like time and tide. We had to go when we could get seats, so early one morning we were ready for the start. Buzzards flew from a feast alongside the field when the propeller whirled. A stalwart government officer had been looking me over, as I stood with motion camera over my shoulder, and I could tell I was guilty of something or other. Finally he stalked over — it was evident he was John Law — and demanded to see what I carried. The Eyemo was produced and he proceeded to confiscate it in the name of the Mexican Republic, declaring it against military regulations to carry cameras in planes.

"But, señor," I said, in my best Spanish, "you can't take my camera."

"But, mister," he replied, in his best American, "I have!"

And it was many a long day before I saw my camera again.

George Dupont Pratt

1867–1935

By Madison Grant

Trustee, American Museum

NATURALLY endowed with a deep interest in Nature, and sincerely willing, throughout his life, to play his part to the utmost in the interests of conservation and education, George D. Pratt, from the time he became a trustee of the American Museum in 1921 until his death on January 20, 1935, was most active in furthering the work of the institution.

His interests were of extraordinary breadth, but he always seemed able, despite his many duties, to give his sincere and personal attention to all of them. Perhaps we of the American Museum felt that our institution held one of the principal places in his heart, for his gifts and contributions were both numerous and great. Yet other institutions and organizations may, with good reason, consider that his interests lay with them at least to an equal degree.

He was vice-president and trustee of Pratt Institute, which was founded by his father, and probably no other institution occupied exactly the same place in his mind. Nevertheless, his wide interests included the Boy Scouts of America, Amherst College, of which he was an alumnus, the Metropolitan Museum of New York, the American Forestry Association, the New York Zoological Society, where he was a member of the Board of Trustees, the American Federation of Arts, the American Association of Museums, and others still, and in many of these he occupied official, and always influential and active positions.

It is, however, principally his connection with the American Museum with which we are concerned here. So varied were his activities in its behalf that many times the space available would still be too little in which to cover them adequately. His generosity was exceptional, his gifts to the endowment fund alone totalling $100,000, and these particular gifts splendidly illustrate his broadmindedness and his keen appreciation of the practical problems confronting the Museum. When, in 1923, an effort was being made to raise a $2,000,000 endowment fund, Mr. Pratt informed the president of the Museum that it was his intention to make a bequest of $50,000 in his will, but that he was willing to make a contribution of this amount immediately if it was so desired, for he appreciated the fact that the income from this sum would be of real service to the Museum in trying times. His generosity in this respect was further emphasized by the fact that he contributed an additional $50,000 in 1930 to the Sixtieth Anniversary Endowment Fund, although his previous contributions had fulfilled completely any personal obligations in this respect.

In addition to his contributions to the endowment, however, his numerous smaller gifts, presented for various purposes in which he was interested, added considerably to this amount. Nor was his generosity shown merely in financial support. Valuable paintings, motion pictures, Japanese prints, archæological specimens, together with other specimens in many categories all came to the Museum as a result of his wide interests and his generosity.

He was just as generous with his time, as well, and during his years of service as a trustee he served on many committees — the Executive Committee, the Auditing Committee, the Conservation Committee, the Committee on Insect Life, the Pension Board and others, while his aid to the Committee on Education, because of his deep interest in the subject, was of exceptional value.

Nor was his interest in the Museum confined only to the time he gave to it. On one occasion, for instance, when he was on a recreational cruise to Norway, he obtained an exquisite series of wood carvings made by the Lapps, and realizing their value to the department of education, presented them to the Museum on his return.

GEORGE DUPONT PRATT
1867–1935
A trustee of the American Museum, 1921–1935

In addition to his interest in the institutions with which he was associated he gathered together a private collection of real merit. As a result of this he was often in contact with importers from whom he obtained many rare pieces. In this way he obtained for the American Museum an unusual collection of prehistoric Peruvian material, consisting of pottery, figurines, and other objects. In the same manner he purchased an exquisite collection of Javanese masks.

Many motion picture films that have demonstrated their educational value beyond doubt came to the Museum in much the same way, and so great was his sense of appreciation when his attention was called to such matters that the films he obtained cover an extraordinary breadth of subject matter.

His major interests, perhaps, so far as the American Museum was concerned, were education and conservation. His interest in conservation was of long standing, and from 1915 to 1921 he served as the Commissioner of Conservation of the State of New York. Thus, in this matter as in others, he was both widely informed and practical in his ideas.

As a result of the deep sincerity of his interests, therefore, he played so exceptionally important a part that his death cannot fail to leave a mark. His invariable willingness to assist in the solution of any problem that was brought to his attention was undoubtedly the principal trait that made him so valuable to the institutions he so generously supported. In his death, all of them have suffered an irremediable loss.

Science in the Field and in the Laboratory

American Museum Activities, Expeditions, Education, Meetings of Societies, and New Members

Edited by A. KATHERINE BERGER

To Study Native Animals of Hispaniola

An expedition to study the strange reptiles and rare animals that inhabit the island of Hispaniola is to be sent to the West Indies by the American Museum of Natural History.

The expedition will be headed by William G. Hassler of the department of herpetology. It will leave New York on March 14th aboard the "Pastores" of the Colombian line. The island of Hispaniola includes Haiti and the Dominican Republic.

One particularly interesting phase of the expedition will be the study of the rhinoceros iguana, which live on a tiny coral island off the coast of Haiti.

It is said that these massive and grotesque creatures are cannibalistic to the point of exterminating themselves, for reports indicate that no young individuals are found,—only a race of hoary old patriarchs apparently living on their own progeny! The life of a newly hatched rhinoceros iguana must be precarious indeed. And among the things the American Museum Expedition hopes to discover is how the females hide their eggs.

From the sea, the expedition plans to explore the interior of Hispaniola which, with its extremes in climatic conditions, its lowlands and its high mountains, still offers vast unexplored areas. Moreover, it has been constantly yielding up new kinds of animals. Many of these have very confined territories. Thus, it is certain that more new things will be found in the wet mountains, the hidden valleys, the deserts and the savanna-lands, when these are penetrated. The expedition plans to work in the most promising and least known of these very regions.

To Colombia for Insects

Research Associate Herbert F. Schwarz of the American Museum, and Mr. E. I. Huntington went to Colombia in the interest of the department of entomology of the American Museum. Mr. Schwarz is in charge of its collection of bees, wasps, and their relatives. Mr. Huntingdon specializes in butterflies. Both of these volunteer workers have already made several very successful trips to the American tropics in behalf of this Museum. The present expedition is certain to add much to the Museum collections and to knowledge of South American insect life.

Ellsworth Antarctic Expedition

A radiogram dated February 1 from Lincoln Ellsworth aboard the "Wyatt Earp" was received by Dr. Chester A. Reeds through the *New York Times*, informing him that five boxes of fossils and Nordenskjold relics from Snowhill Island were being shipped from Montevideo to the American Museum. These will be placed on exhibit with other material gathered by Doctor Ellsworth on his polar expeditions.

March Program, American Museum Educational Activities

The following lectures are announced for March by the department of education of the American Museum:

1. Lectures For Members (Alternate Thursdays at 8:15 P.M.)
   March 14 "A New Dinosaur Kingdom," by Barnum Brown
   March 28 "Camping in the Canadian Rockies," by Frank R. Oastler
2. Nature Stories for Children of Members (Alternate Saturdays at 10:30 A.M.)
   March 2 "Nanook of the North," Introduced by George H. Sherwood
   March 16 "Mool, a New Guinea Boy Hunter," by Margaret Mead
   March 30 "Just Out-of-Doors" by Paul B. Mann
3. Know Your Museum Series (For Members) (Alternate Tuesdays at 8:15 P.M.) by Herbert P. Whitlock
   March 5 "Jade: Its Carving, Mythology and Symbolism"
   March 19 "The Drummond Collection: Section of Antique Jade"

On the evening of February 8, the department of education entertained members of the United Parents Associations of New York City, Inc. On this occasion parents of school children of the city were shown the educational facilities of the Museum, and various kinds of school aids were exhibited so that the parents might have a clearer understanding of what the Museum's school service is doing for their children.

Under the auspices of the United Parents Associations of New York City, the department of education will give a series of five radio talks over Station WNYC on Friday afternoons in March, from 5:15 to 5:30 P.M. These broadcasts will emphasize the relation of the Museum to the school, the child, and the parent.

On Tuesday evening, February 19, the department of education entertained some fifty prominent educators of the city, including the district superintendents and representatives from several colleges in the city. An informal dinner was followed by brief addresses by Doctor Sherwood and Doctor Granger, and then a short tour of Museum halls was made.

In addition to the regular Wednesday afternoon concerts in the Museum auditorium by the New York Civic Orchestra, free concerts by the Greenwich Sinfonietta are being given on Sundays at 2 P.M.

The time of the meetings of the Thoreau Nature Club for children has been changed from Saturday afternoons to the second and fourth Thursdays at 7:30 P.M.

The Hayden Planetarium

The Zeiss Projection Planetarium instrument has arrived in New York from Germany. It has been removed from the docks to a fireproof warehouse, where it now awaits its installation in the planetarium building when that building is completed.

The most interesting development in the work on the planetarium building during the month of February has been the placing of the first stainless steel plates on the inside of the dome. These steel plates are perforated with small holes in order to improve acoustics. A circular plate is first attached to the exact center of the dome and then the others radiate out and down from it. When completed, the stainless steel is painted white and the perforations become invisible.

The Amateur Astronomers Association

During March the Amateur Astronomers Association plans to carry on its regular radio programs on Tuesday afternoons from 3:30 to 3:45 over Station WOR. The schedule is as follows:

March 5 Miss Dorothy Bennett, "Meteors"
March 12 Mr. Arthur Draper, "Famous Meteorites"
March 19 Mr. Herbert H. Wilbur
March 26 Mr. James C. Hickey

The Amateur Astronomers Association announces that at 8:15 P.M. on March 6 and March 20 Dr. E. E. Free will give the first two in a series of three talks on "Astronomy and Astrology." His subject for March 6 will be "How and Where Astronomy Began: Hours and Days Among the Sumerians of 6000 Years Ago." On March 20 his subject will be "The Great Days of Astrology: When Star Watchers Were the Best Advisers in Economics."

The Junior Astronomy Club

The Junior Astronomy Club activities include lectures as follows:

March 2 "Mercury," Hugh S. Rice
March 16 "Origin of the Solar System," Dorothy Schoof
March 30 Motion Pictures, Elections

Weekly radio program on Saturdays at 4:30 P.M. over WINS:

March 2 "Spring Constellations," Lois Saphir
March 9 "The Earth, a Measuring Rod," Alfred Alk
March 16 "First Magnitude Star," Helen Kuchuk
March 23 "Dramatic Sketch on Galileo," Hubert Bernhard and others
March 30 "Pluto," Hubert Bernhard

The club publications, the "Handbook of the Heavens" and the *Junior Astronomy News*, carry the club's message into almost all the states of the union.

South American Indian Material for the American Museum

Dr. Harvey Bassler has presented to the department of anthropology a large and complete ethnological collection from Northeast Peru. Many years of travel in this jungle country on the eastern slope of the Andes brought Doctor Bassler into contact with about fifty Indian tribes who still inhabit this region. The main body of the collection comes from the Chama Indians, although the Jivaro, Witoto, Boro, Schimaku, and many others are well represented.

While there are many unique specimens in the collection, the great value lies in its completeness. Every phase of Indian life is represented, not just the more artistic or the unusual. In this collection we find the infinite variety of the potter's art, weaving from spindle through loom to finished cloth, the total contents of an Indian house. Here are the weapons of the hunter and warrior, stone clubs, bows with poison-tipped arrows, spears, traps, and the typical blow guns. At the same time we find the children's toys, counterparts of their fathers' weapons, such as small bows, darts, and reed blow-guns, with which they play at fighting and hunting. The collection gives us a picture of what the Chama Indians wear. Their costumes for every day use are accompanied by the elaborate masks, bark cloth and grass skirts of the dance. Every variety of seed, shell, nut, tooth, and bone bead is represented. Ear plugs, lip plugs, wristlets, feather headdresses, fur caps, stuffed bird ornaments, and bamboo splint combs show the adornment of the Indian. If we are interested in the music we can examine the musical bows, the variety of bamboo and bone flutes, and the leather-headed and wooden drums. The ramifications of design can be studied in the painted vessels, the decorated cloth, the carved wooden paddles, and in many small designed objects.

It is not possible to list the total variety of the collection. Fortunately most of the specimens have already been studied and illustrated in two books by Günter Tessmann, *Die Indianer Nordost-Perus* (Hamburg, 1930) and *Menschen ohne Gott* (Stuttgart, 1928), which were published under the supervision of Doctor Bassler. This collection represents the finest picture of a modern South American Indian community that the Museum possesses.

Tropical Plants

With the recent dismantling of the tropical greenhouse in Central Park, the laboratory of experimental biology at the American Museum has acquired a large series of valuable plants. There are many ferns, epiphytes, and rapid growing vines, which have been installed in the greenhouses of the Museum. The gift also included a series of tree ferns, two palm trees, and several banana plants. These tropical plants will be of great assistance in stabilizing the moisture content of the greenhouses. They will also be available for temporary installation in the exhibition halls on the occasion of special demonstrations.

Tropical Fish

Mr. John H. Phipps has recently presented a collection of live tropical fish to the laboratory of experimental biology at the American Museum. These will be available for various physiological studies being carried forward at the present time by several members of the laboratory staff. Mr. E. A. Candidus, who recently was elected president of the New York Aquarium Society, has also coöperated in the studies on living fish. He has presented a series of valuable specimens and has also given much of his time toward properly installing them in tanks.

A Subtropical Fish Visits Newfoundland Coast

Through the kindness of Mr. Ernest Ingersoll, the department of fishes of the American Museum has received a dried filefish (*Alutera scripta*), about six inches long over all, from Stone's Cove, Fortune Bay, south coast of Newfoundland, which was sent for determination to the *Family Herald and Weekly Star* of Montreal, and mentioned in the issue of that paper for December 19, 1934. The specimen is interesting because this is a sluggish, mostly West Indian fish, which drifts in the currents, and its occurrence so far to the northeast shows how widely warm subtropical water must have been spread in the western Atlantic in the fall of 1934. Mrs. Henry Miller writes us from Stone's Cove that "it was hauled into a herring seine while hauling small herring for bait. The date was Sept. 25, 1934." — J. T. N.

American Game Conference

The twenty-first annual meeting of the American Game Conference was held in New York on Jan. 21, 22, and 23. Several members of the staff of the American Museum attended sessions, which were of interest to conservationists and to those interested in mammal and bird problems.

Dr. H. E. Anthony attended, during this period, a meeting of the Federal Elk Commission as a member of one of the subcommittees of that body. The increase in numbers of the Northern Yellowstone elk herd beyond the capacity of the available range has made it necessary to adopt drastic measures in order to bring the numbers into harmony with conditions as they exist. The National Park Service has proposed, as a last resort, the killing of a certain number of these animals after the hunting season has taken its toll, and it was the consensus of opinion at the meeting of the Federal Elk Commission that this plan was constructive and should be endorsed.

At the close of the Conference the Resolutions Committee reported. During the Conference one of the important issues was the duck shortage throughout most of the States where these birds are shot, a matter of much concern, and it was hoped by many that a resolution would be offered which recognized the shortage as a disturbing element. The conservationists even hoped that the Conference would go on record to advocate a season of no shooting at all. However, this issue was avoided by an expression of confidence in the U. S. Biological Survey, in whose hands the whole problem was placed. An independent resolution offered from the floor calling for a closed season failed to carry.

Imperial Mammoths

Professor Osborn is preparing for NATURAL HISTORY another article drawn from his great monograph on the Proboscidea, which is now on the American Museum press after twenty-seven years of preparation. The Imperial Mammoths of the United States and Mexico represent the culmination of a long line of descent and of migration which is traced back to South Africa through discoveries in Saskatchewan, in the Pliocene Siwaliks of India, various parts of the old kingdom of Austria, in southern France, northeast England, north Africa, and then by a great leap to the earliest known ancestors through discoveries of grinding teeth in the terraces of the Vaal River valley of South Africa. Most generously Director Wilman of the McGregor Museum in Kimberley, South Africa, has made a temporary loan of six specimens of the most interesting types of Proboscidea that have ever been discovered; these grinding teeth reveal in the most convincing manner a heretofore theoretic transition between the simple-crested mastodon type of molar and the multiple-crested primitive molar of *Archidiskodon*, a genus which derives its name from Greek words signifying archaic-disked-tooth. Along the Vaal River terraces in Pliocene time lived the small ancestors of the Imperial Mammoths, about the size of a baby elephant, with extremely simple mastodon-like grinding teeth.

Great Imperial Mammoths grew from these small South African forest- and river-border-dwellers.

The evolution and migration of this transcendent branch of the African proboscidean stocks migrated northward and reached southern Europe in Upper Pliocene time. On the southeast coast of England it was associated with the Piltdown man, *Eoanthropus*. Most remarkable is the fact that these Imperial Mammoths entirely disappeared in Europe and, traversing Asia and the Bering Strait land bridge, passed through Saskatchewan into Nebraska in Early Pleistocene time, where they flourished in great herds. Finally, during Late Pleistocene time they advanced southward into Mexico and became extinct before the final Ice Age.

Honors

At the second Pan American Conference of Eugenics and Homiculture which convened in Buenos Aires, Argentine Republic, November 23–25, 1934, Prof. Henry Fairfield Osborn, together with Major Leonard Darwin and Prof. Charles P. Davenport, was unanimously elected honorary president.

Appointments

Members of the American Museum as well as the Scientific Staff will be delighted to learn of the appointment of Prof. Othenio Abel, lately Rektor of the University of Vienna, to the professorship of geology and palæontology in the University of Göttingen and directorship of the Geological and Palæontological Institute and Museum. Professor Abel is known in America not only by his brilliantly written popular volumes covering the whole field of vertebrate palæontology, but also as a most welcome visitor to the western fossil fields of the United States about ten years ago. — H.F.O.

Bird Paintings

An unusual collection of paintings depicting the shore birds of South Carolina, birds of wood and rice fields, and warblers of eastern North America, was on exhibition in Education Hall of the American Museum from December 17 to 29. The artist is Edward von Siebold Dingle, of Middleburg Plantation, South Carolina.

Recently Elected Members of the American Museum

The membership department lists the following persons as having been recently elected members of the American Museum:

Annual Members

Mesdames Paul Achilles, L. C. Leeds, Arthur L. Zerbey.
Messrs. David G. Ackerman, Howard L. Hastings, Robert D. Holbrook, Hugh Knowlton, George Rocker, Charles T. Sibley, Thomas A. Yawkey, J. S. Zinsser.

Associate Members

Mesdames John Moseley Abbot, Eleanor B. Ackerman, Evelyn W. Adams, M. A. Armstrong, D. K. Bartlett, Helen L. Becker, Robert S. Bickley, Helen N. Blanchard, Adolphe Boissevain, J. E. Brantly, Walter Breslav, Dwight L. Brown, Wallace Murdoch Campbell, James L. Carrick, Jean Carroll, Marion F. Chamberlin, A. Therese Christopher, Anna M. Cole, Margaret M. Comans, Frances H. Consalus, Persis M. Cope, Waldo E. Cummer, Daniel R. Davis, Dorothea diPretoro, Augusta Dickinson, C. S. Dickerson, Augustus Van Horne Ellis, E. P. Ellwood, Richard D. Ely, M. W. Ensign, Josephine M. Fabricant, Dinah Friedland, J. F. Guthrie, Charles A. Hambly, Charles H. Hampton, H. B. Harshey, Michael Heidelberger, B. Holland, Walter Huber, J. W. Huger, J. E. Ingram, H. E. Jewett, Alfred G. Kay, Floyd E. Keir, Hazel E. Keirstead, Joseph A. Kelly, S. W. Kinyon, Edgar A. Knapp, Charles J. Knudsen, Ethel E. Larsen, Walter B. Lashar, F. H. Lovell, Robert Hardin May, Alfred G. Mayor, Edward A. Middleton, George Moore, Ethel Morrison. Henry J. Newman, George Notman, Madge Osborne, M. B. Owens, W. W. Parker, Morton E. Peck. Emma R. Piatt, Oscar Wentworth Place, Emily Noble Plehn, Reynolds Pond, E. E. Pottberg, Glenn S. Reeves, Carl E. Seabergh, Theresa Shales, Thomas E. Sharp, George Simson, Jr., Lilian White Spencer, Emma H. Stillman, R. E. Strawbridge, Jr., L. P. Sturges, Charles H. Talcott, S. B. Theler, Alvina Todd, Wm. J. Tucker, Hannah T. Vosper, Elizabeth H. Weeks, Helen B. Wilson, R. E. Wolf, J. H. Wood.
Sisters M. Luke Gough, Mary Bertha.
Misses Rae Abraham, Alice A. Adanalain, Elisabeth Bass, Ruth Beals, Irene M. Bear, Grace Griffith Begle, Lillian H. Bergman, May L. Bering, Elizabeth A. Billings, Hazel Blair, Margaret Blossom, Anna C. Bowen, Helen R. Braem, Eva S. Browning, Helen M. Burgess, Julia R. Bush, Marie E. Carlson, Florence L. Case, Emma L. Caten, Gertrude Chandler, Judith Churchill, Edith Ann Clarke, Josephine Cleary, B. Eleanor Collins, Andrea A. Cook, Anne B. Cook, Amelia K. Counsellon, Nellie P. Covert, Anne Dacks, Angeline M. Dean, Babette de Guery, Ruth C. DeMund, Grace Denny, Gisella Divisich, Sarah G. Evans, Geraldine Ewald, Paul L. Feiss, Bertha S. Finkelstein, Beulah Thornton FitzHugh, Clara Fleischauer, Elsie Freedman, E. Lena Gallop, Irene P. Gebhardt, Esther M. R. Gilbert, Ruth Gillespie, Cecelia M. Grossman, Eleanor Hague, Jennie Hall, Maria Clemencia Hand, Kathryn F. Hanley, Anne Harmon, Corra Harris, Mary F. Hayes, Marie A. Hickey, Harriet Hinman, Jennie Hirshhorn, Sara F. Hoadley, Myrtle E. Hofmann, Evelyn Hoke, Harriett Hollmann, Alice H. Hooper, Florence E. Huber, Elizabeth H. Innes, Leila Israel, Grace E. Jackson, Mina S. Jacobsen, Martha Jenkins, Marie L. Keese, Rose Marie Kiefer, Alison Kimball, Augusta C. Kramer, Angelique C. Kroll, Caroline E. Lawlor, Annie R. Lawrie, Marion L. Little, Isabel Loomis, Frieda Lubelle, Mary K. Lucey, Hazel B. Mackel, Margaret C. Mackintosh, Constance G. Maisner, Opal May McClarren, Elizabeth McConnell, Delphine B. McCready, Doris McDaniel, Ruby McDonald, Josephine M. Merrill, Mildred Z. Mockus, Ruth C. Molyneaux, Almarine Moore, Margaret Moore, Helen E. Morris, Jennie D. Morse, Dorothy A. Mott, Neva Munson, Mary E. Ochsenhirt, Esther C. Olsen, Marjorie Ada Parsons, Fleda Perry, Mattie Jean Phelps, Ruth L. Phillips, Pearl Pope, Pauline Pruzan, Hallie E. Queen, Camilla M. Radoyevich, Elizabeth S. Rawlinson, Polly Robinson, Pearl Salsberry, Edith F. Scaife, Margaret A. Schorr, Janet M. Seister, Maude M. F. Shafer, Leah Sherwood, Cecile M. Shoket, Hattie Shy, Joan Bentnick Smith, Leona A. Smith, Rose Steinhardt, Bertrice Z. Streeter, Anita Tarbell, Gertrude M. Tell-Key, Jane Ten Broeck, Retta Thomas, Melanie Thompson, Phebe Tibbetts, Estelle Tischler, Willametta Turnepseed, Emmy R. Turner, Ella Mae Vanderboget, Mary G. Van Meter, Elvera E. Veltri, G. Ouida Vorhis, Bessie M. Wallace, Elizabeth Walter, Florence S. Ward, Marie L. Weldon, Marion Weschler, Louise Whitaker, Elizabeth Whitney, Elin Wikander, June E. Willis, Gertrude Wolfer, Annie Lee Wright, Julia Elaine Yacos, Anna R. Zager.
Reverends John C. Carey, Patrick F. Doyle, Wm. H. Hudnut, John J. McEnearney, M. B. Nash, Walden Pell, 2d, Harvey C. Porter.
Major-General Prince Cantacuzene
Brigadier-General Jay J. Morrow
Colonel Townsend Whelen
Lieutenant Colonel Frank M. Kennedy
Major Louis Lipton
Lieutenant Frank J. Vida
Doctors Abram J. Abeloff, M. B. Ahlborn, William Brewster Allan, William Antofol, Benjamin Apfelberg, John P. Arcieri, Edythe A. Bacon, L. P. H. Bahrenburg, R. P. Ball, Joseph Bardy, Frank G. Bass, George L. Becker, George Beebe, George W. Bellano, Abraham J. Beller, Norman C. Bender, L. N. Bergh, Max Bernanke, Ernst Bischoff, J. Hudson Blauvelt, H. Borshaw, W. H. Bunn, C. Charles Burlingame, Maryesther Burns, John D. Butzner, Plumb Brown, Edward J. Campbell, Joseph I. Cantarow, Frank Riley Castleman, Fred T. Cavanaugh, Daniel E. Chase, Albert Claude, S. A. Coffin, Sidney Cohn, J. de R. Combes, Mary E. Conrad, Ethel L. Cornell, George S. Cotton, H. W. Cowper, George H. Crooker, Louis Dantzig, William E. Davis, E. C. Day, Frederick M. Dearborn, M. P. De Boe, Nicholas H. D'Gianni, Charles L. Dichter, C. W. del Plaine, M. Downey, Cecil C. Dustin, Lucien Y. Dyrenforth, L. F. Egen, Herbert Elftman, DuMont F. Elmendorf, Alfred C. Emmel, Joseph Erdman, Paul J. Ewerhardt, E. J. Eytinge, Louis E. Fazen, Julius Fechner, W. G. Felcyn, George B. Fernlund, John P. Ferrara, Otho A. Fiedler, Charles D. Freeman, Amos Edgar Friend, Lewis F. Frissell, John Gardner, Wm. V. P. Garretson,

Manfred J. Gerstley, Newell W. Giles, William Goldstein, Louis Greenberg, William W. Hala, Wayne W. Hall, I. Halpern, H. S. Harris, W. H. Haskin, David A. Heffernan, Charles Herrman, Robert L. Hill, E. S. Hodgson, Stephen G. Holster, Ralph S. Holtzhausser, Charles Bertram Horton, Wm. S. Hubbard, Henry T. Hutchins, Sidney Immergut, Robert L. Irish, C. N. Johnson, J. Murl Johnston, F. O. Kendall, Lawrence S. Kubie, Llewellyn R. Lewis, O. J. Letherman, James R. Lincoln, Thomas Ollive Mabbott, Elviro Mancusi-Ungaro, D. Marini, William A. Marracco, Frederick W. Marx, Joseph C. Matera, Charles A. McDonald, Ralph A. McDonnell, Erwin C. Miller, Ashley B. Morrill, W. C. Mudgett, Norman C. Ochsenhirt, Paul Outerbridge, John J. Pagliughi, Harry V. Paryzek, Joseph C. Patrick, Voyle A. Paul, W. J. Sweasey Powers, W. J. Probst, C. M. Richter, Homer E. Ring, George Rosenberg, Joseph R. Rudder, H. C. Russell, Kaufman Schlivek, I. F. Scofield, Clifton R. Scott, Harry Sherwood, Benjamin F. Sieve, Ambrose V. Sloan, Dorland Smith, Groves Blake Smith, R. F. Smith, Robert L. I. Smith, Stanley Smith, Fred P. Solley, James G. Spackman, Zella White Stewart, B. P. Stivelman, Eugene Swope, John B. Talmadge, Charles Edwin Teeter, Benjamin T. Tilton, John B. Todd, Charles C. Trembley, Philip Layton Turner, David R. Ulmer, Joseph E. Uridil, Henry T. von Deesten, Philip C. Washburn, Charles Reed Weeth, Miley B. Wesson, Leonard Wheeler, E. D. Whitehouse, S. F. Wildman, Hugh Williams, John D. Wilson, Charles R. Witherspoon, Roger P. Wodehouse, W. Beran Wolfe, George B. Wood, W. H. Woody, Reuben S. Young.

Professor Doctor H. H. Reese.

Professor John W. Wetzel, L. L. Leh, Vladimir Karapetoff.

Honorable George L. Emery

Messrs. Bjarne Aanning, Philip Abramovitz, Stanley A. Abercrombie, Julius Abramson, J. N. Adam, Charles E. Allen, Chas. S. Allen, Jr., William G. Allen, Stephen J. Allie, H. O. Ambrookian, G. J. Anderson, DeLano Andrews, E. J. Angell, T. H. B. Armstrong, Henry R. Ashton, James C. Atkins, Charles T. Atkinson, H. R. Austin, Mickey A. Bailey, A. C. Bakken, Ray L. Baldwin, Raymond E. Baldwin, Jr., Edward L. Ballard, A. D. Barber, Alvin B. Barber, Jr., A. A. Barker, C. Grant Barnes, Harold A. Barnhart, George E. Barrett, William Felton Barrett, William F. Barry, Theodore D. Bartels, R. E. Barton, A. Elliott Bates, George Harmon Bayles, Andrew J. Beacom, William W. Beaman, Frederick Morgan Beasley, R. R. Beatty, McWorter Beers, Paul Eugene Belcher, D. B. Bell, Charles W. Belmer, Sam H. Benbow, W. M. Bennett, Jr., E. R. Bentley, Frank M. Benton, S. Haldeman Bibler, Paul S. Bixler, William R. Black, Robert O. Blair, Michael V. Blansfield, William Rutger Bleecker, Edgar Howard Boles, Floyd E. Booton, Arthur G. Boughner, Loy J. Bowen, William Brady, Carson Brevoort, Niels-Eske Brock, Waldo Emil Bromund, George F. Broth, W. Lee Brown, Louis E. Browne, Albert C. Buehler, John Bunyan, George Burkard, G. P. Burkhart, H. DeWitt Burrell, Charles M. Burtis, Harold E. Burtt, R. J. Buster, Grafton Butman, J. William Buzzell, J. Raymond Campbell, W. P. Campbell, Herman M. Campsen, Jr., George Howard Capron, William L. Carroll, Walton C. Carron, Hadley C. Case, Clayton P. Chamberlin, Albert D. Cheston, John Needels Chester, W. E. Clark, Howard F. Cline, Albert D. Cockey, Frederic Cohn, Irving L. Cohen, Henry E. Coleman, W. H. Collins, Rexford H. Conant, Edmund W. Corrie, J. Forest Craig, Kenneth R. Crawford, George F. Crow, Dan M. Crowder, R. F. Crowell, John R. Crunkleton, George Gilman Dairs, Marshall Dancy, Paul F. Dahlgreen, William G. Davey, John C. Dennison, R. Auzias de Turenne, Meade C. Dobson, V. C. Doerschuk, Lawrence Doty, W. K. Dougherty, J. M. N. Downes, Archie W. Dunham, Richard F. Durning, C. R. Duroe, J. C. Drouillard, Jos. S. Eckert, Samuel W. Eddy, Verne G. Edgcumbe, Harry Madison Einhaus, William T. Eldridge, R. D. Ellington, Charles F. Elvers, Martin F. Ernst, Henry P. Erwin, Nathan A. Estes, Jr., Samuel J. Ettinger, W. R. Everett, Thomas B. Ewalt, Bernard B. Fallon, S. S. Farley, Charles Fehr, Herbert U. Feibelman, Wm. F. Ferguson, John L. Fiedler, William Edwin Finch, Jr., Chas. S. Fisher, Herbert C. Fister, Tirey L. Ford, Theodore Fossen, Thomas B. Frank, Arthur Fried, Charles Froelicher, Frederick G. Frost, Jr., Frank J. Fuhrmann, George B. Furman, Martin Gabriel, E. B. Gaylord, J. H. Gaines, Joseph R. Gannon, Stanley R. Gardiner, Robert L. Garner, Saxon B. Gavitt, William Gehin, Martin Gehringer, Wm. E. Gerstenberger, John R. Gibb, Chas. D. Glennie, Charles C. Glover, Jr., Herman C. Gordon, John H. Graham, H. F. Graper, Robert L. Graves, T. Y. Gregg, Addison L. Green, Samuel H. Greene, Abraham S. Greenberg, James Van Zile Greenleaf, Benjamin Greenspan, Joseph A. Grieshaber, Peter Grimm, H. H. Griswold, George A. Group, Frederic R. Gruger, Arthur Gruhlke, W. H. Grunert, H. M. Gullette, T. M. Gullette, J. Ardwin Gustaferri, Basil M. Gwathmey, Demosthenes B. Hadjopoulos, Louis Hagen, G. N. Hakes, Theodore H. Hammett, Wm. Hanemann, John F. Hannigan, Chadwick Clarke Hansen, Frederick W. Harnwell, Harry Gordon Harper, H. A. Harrell, E. H. Harris, Bruce Harrison, F. C. Hartshorne, John J. Harvey, Carl G. Harwig. George C. Haseltine, Robert Hasenclever, Chas. Hasler, Norman L. Hatch, August E. Hauck, Nathan E. Hause, Jules L. Haut, Truman D. Hayes, Alexander M. Herd, J. Marvin Herman, Paul R. Heyl, Hamilton Higbie, Jr., Harry E. Hill, John F. Hill, Bert Hindmarch, F. W. Hinrichs, Jr., Henry A. Hoadley, Stuart Hoadley, C. Stuart Hoag, Charles C. Holmes, Joe Hood, Franklyn C. Hopkins, George Hoppe, C. W. Hord, Benjamin F. Horner, C. M. Houghton, Roy A. Hovey, Donald W. Howe, Chester W. Hoyt, Frank J. Hughes, John H. Hughes, Chas. S. Hunter, Frederick M. Hunter, J. W. P. Huntington, Edw. J. Hurni, Fred Wilson Isles, John S. Ivy, Robert T. Izant, 2d, Frederick T. Jacobs, Louis T. Jamme, Eugene Janinski, Louis D. Jantzen, Jr., Henry N. Jasper, B. W. Jenks, Jr., Elmer H. Jennings, Hubert P. Jewell, Solomon A. Joffe, Maynard R. Johnson, Clarence H. Johnston, Abraham J. Katz, Earle F. Kaufman, Roddie Kennedy, William H. Kennedy, Robert Kerr, G. A. Ketcham, R. T. Kimbrough, Fred J. King, Kephas Albert Kinsman, Arthur F. Kittredge, Jr., Adolph H. Klein, Jacob A. Kline, Frederick A. Knauer, Karl Werner Krauss, Mathias Mason Krenn, Joseph Kurdle, Frederick A. Lange, G. A. Landry, J. H. Latham, L. J. Lauerman, Morton A. Lazarus, Roger I. Lee, Harry LeMoyne, Richard Lenz, Harry A. Leverson, Warren E. Lewellen, Arch. G. Lewis, J. R. Lipscomb, Billy Lombardi, Nathaniel R. Lubowe, Charles R. MacDonald, Douglas B. Maggs, P. A. Mann, Moncure March, Louis S. Marchiony, Ildo E. Marchisio, Charles Martyn, W. D. Mason, A. Audley May, S. E. McAfee, C. B. McAllister, John B. McAllister, H. N. McAshan, T. W. McCullough, John B. McDougal, Harry B. McGown, T. J. McGrath, Robert E. McKinney, Ronald McKinnis, Daniel D. McMasters, Ralph McNiel, W. E. McNulty, Hugh Means, Frederick H. Meeker, C. A. Merriam, S. S. Merriam, E. B. Merrill, T. N. Metcalf, Albert C. Metzger, Samuel Metzger, John Middleton, R. C. Miller, J. Willard Milnor, E. Ross Mintz, Richard J. Money, Robert Moody, Howard Morse, Jr., C. Moyle Mosher, Ernst W. Mueller, Chester G. Myers, Orvil F. Myers, Louis J. Neidert, R. C. Neuendorffer, Albert Neuman, Edward Abbe Niles, Edwin R. Noll, Avery Norwood, Jr., Hume K. Nowlan, Charles J. O'Connor, Chester M. Ogden, Frank G. Olsen, Henry G. Oppmann, Joseph F. Padlon, Norman W. Palmer, Ray Greenleaf Palmer, F. E. Parker, O. H. Pathoven, Lee S. Pattison, J. A. Pfeil, W. L. Peel, George A. Pettitt, Ralph E. Pickett, Jr., Nathen Pigovat, Benjamin C. Porter, Stanley W. Potts, John T. Presley, Harold C. Puffer, Charles William Quinn, Frank L. Rainey, John E. Ransom, A. Rayburn, H. K. Raymenton, Harold E. Read, David W. Rial, August W. Rehberger, Charles W. Reihl, M. D. Reinhold, Lewis G. Reynolds, William P. Rheuby, J. Gordon Rhinehart, Emerson Richards, Rodman Richardson, Lee J. Richey, W. A. Rigby, Wm. H. Rippel, J. W. Robertson, James F. Robinson, J. S. Rockefeller, Jr., Donald West Rockwell, J. H. Rodes, Charles W. Rosenberg, Benjamin Rosenthal, Clayton Elbert Royce, Stewart G. Russell, Morris Rutherford, Wheeler Sammons, Ira A. Sasserath, H. W. Scallin, Benjamin Schellenberg, C. C. Schmelz, C. W. Schroeder, Edgar H. Schrupp, Edward C. Schultze, Otto Schumm, Julius Schwartz, H. E. Schweizer, Carl F. Scott, Grenville Allen Scott, William H. Scoville, Henry C. Sears, H. A. Seltsam, Stanley N. Shaw, John P. Shefke, L. W. Sherer, D. H. Sherwood, Edward E. Shields, Walter C. Shorter, Herbert E. Shumate, Maurice H. Silverstein, A. E. Smith, David H. Smith, Edward F. Smith, Leon B. Smith, Nelson C. Smith, T. Wood Smith, Tracy Smith, John I. Snyder, Roger S. Sperry, Phineas Sprague, William A. Sprague, Chas. E. Springmeyer, H. P. Stamback, E. B. Stanley, Oliver H. Stansfield, Alfred E. Stearns, John L. Steele, Edgar A. Stevens, Dugald Stewart, George W. Stewart, George W. Stonebridge, Richard Strauss, George W. Sumers, Clarence W. Sutter, W. Emmert Swigart, Edward L. Taliaferro, W. A. Taliaferro, Chester Talley, Jr., Ronald P. Tappen, R. H. Taylor, R. J. W. Templin, Charles E. Terney, F. W. Thomas, John J. Thomas, Chas. L. Thompson, M. T. Thompson, R. H. Thompson, Jr., Charles H. Thornton, Louis W. Tilden, Halford T. Tillson, Edwin H. Titus, Samuel L. Tucker, Charles B. Tuller, Alvin Broadus Turnage, John Turner, T. E. Tuthill, J. Lee Tracy, Lewis J. Trounstine, Lynn Troxel, Robert M. Unger, Stephen Valentine, L. H. VanBuskirk, Cyril Vancura, Cornelius Van Malsen, Earl K. Van Steenberg, Walter L. Van Syckle, Charles W. Vincent, Gregory S. Vojae, Fred M. vom Saal, Harold E. Wade, Dwight H. Wagner, George Wahr, Guy A. Waineright, Hall Walker, Harold H. Walker, J. A. Walker, Joseph Walker, Weyman Walker, C. C. Walsh, C. Grenfell Warner, John B. Warren, Charles Wasserburger, G. S. Watson, E. W. Weatherly, A. E. Weaver, Charles G. Webb, Lyel T. West, Stephen White, S. E. White-Spunner, Adelbert A. Whitford, Smith N. Whitworth, Frank J. Wiget, Benjamin Williams, G. Cooke Williams, Henry P. Williams, Thomas S. Williams, E. Homer Wilson, John Wisdom, William L. Wolfson, Herbert S. Wood, C. K. Woodbridge, Edward M. Woodward, Jr., Robert VanLear Wright, Jr., Julien D. Wyatt, W. W. Wyckoff, William Charles Wylie, Frederick W. York, Richard B. Young, Charles S. Zabriskie, John A. Zellers.

Reviews of New Books

Recent Publications for Those Interested in Nature

Adam's Ancestors. By L. S. B. Leakey. New York: Longmans, Green and Co. 1934.

THE bold title of this book indicates the general tenor of its contents. Written by a young East African archæologist of English descent, who has had remarkable success in his home field researches, the volume bristles with new facts and new ideas, some of which may be expected to excite lively discussion.

It is impossible here to give the treatise its duly merited consideration on all points, but it is a handbook which seeks to present in summary fashion all the more prominent facts and interpretations regarding Paleolithic man and his culture. Accordingly, after dealing briefly with geological and paleontological questions, several chapters are devoted to physical anthropology, or rather osteology, with a view to demonstrating the opinion long held by Sir Arthur Keith that the modern racial type, *Homo sapiens*, is of much greater antiquity than has hitherto been generally believed. In support of this view, the author has found in East Africa certain jaw and skull fragments, associated with Chellean artifacts, which, with other hitherto disputed skeletal remains, would seem to prove that the famous Cromagnon man of European Aurignacian times was not the earliest physical representative of his type.

On the cultural side the author supplies a very interesting chapter on flint-working technique, based at least in large part on his own experimentations. He next gives a descriptive account of the successive Paleolithic flint industries, in which he brings together all the latest discoveries and observations by the Abbé Breuil of Paris. The chief outcome is that the Middle Paleolithic stage, generally regarded as embracing the Levalloisian and Mousterian industries, has been considerably expanded as to time duration and also as to differentiation in technique, the result being that among these flake industries a new phase known as the Clactonian has been recognized. The Levalloisian and Clactonian flake industries are regarded, on the one hand, as contemporary and as parental to the Mousterian industry, and on the other, as running back to Chellean times, thus paralleling the core industries represented by the coup-de-poing or hand-axe of Chellean and Acheulian characteristics. The suggestion is made that these contemporary but distinguishable flake and core industries are the products of different racial groups, the first belonging to the Neanderthal man, now extinct, and the second to the early ancestors of modern man.

The little book is written in readable, even at times exuberant, style; and, barring portions of chapters 5 and 6, may be read with both profit and enjoyment by the layman. The specialist will doubtless take the author to task for his new definition of the Pleistocene, his opinions about man's relation to nature, the relation of bone to tissue, and especially his rather positive assertions on such subjects as, for example, patination. But taken as a whole the book is timely and well worth the specialist's consideration. — N. C. N.

Field Book of Insects, Third edition, rewritten to include much additional material, with about 800 illustrations, many in color. By Frank E. Lutz. New York: G. P. Putnam's Sons. 1935.

WHEN the first edition of the Field Book appeared, in 1918, a distinguished American entomologist, looking it over, exclaimed: "Why has this not been done before?" There were several good reasons why it had not been done. Most entomologists are specialists in some one or two orders, and feel disinclined or incompetent to discuss the others. There are indeed many who are teaching in the universities, and some of these write excellent text books, which survey the field from the standpoint of a laboratory instructor. Such texts largely fail to meet the needs of the amateur, who wants to know about each insect he finds, "What is it?" and "What does it do?"

It appeared to Doctor Lutz that we were living in a world full of beautiful and interesting things, capable of stimulating equally the æsthetic and intellectual faculties, and that to ignore all these marvels was to deprive ourselves of a great deal of pleasure which could be had practically without cost, and within a short distance of our homes. Indeed, with the Field Book and a fairly good garden, one could find employment for a year. An English amateur entomologist, S. T. Klein, was in his later years an invalid, confined to his couch, but he spent a great deal of time in his garden, and wrote a charming little book on his experiences there.

Doctor Lutz has on exhibition at the American Museum a collection from his garden in the vicinity of New York, and the number of species found is astonishing. Even such an unpromising locality as the paved court of the British Museum at Bloomsbury, London, furnished the entomologists of that institution with a considerable collection, including some rare species. They picked them up as they crossed the court on the way to and from their work.

The world of insects being thus literally at our feet, we can find in the Field Book a vast amount of information enabling us to learn something about almost anything we may find. Emphasis should be laid on the fact that we ourselves can learn what we want to know, and are not obliged to run to an entomologist or send our specimens away in order to get the beginning of knowledge about them. It is better fun, and much more profitable in every way, to help ourselves. Later on, when we know more about the subject, it will be necessary to get other kinds of help.

For the butterflies, grasshoppers, dragon flies, and some other groups there are books which make it reasonably easy to determine the species, at least in the northeastern and central states. In the case of other groups, the books are still inadequate, and the young amateur may perhaps dream that he will be the one, some day, to smooth for others the rough path he has toiled over. When all is done, and we have for the United States such splendidly illustrated and complete works as Edmund Reitter's *Die Kafer des Deutschen Reiches*, the collector will have an easy time; but are there not some who would rather be the pioneers, living in the days of hard work and the discovery of new territories?

As I was preparing this review, there came to hand Dr. P. P. Calvert's account of E. B. Williamson, of Bluffton, Ohio. (*Entomological News*, January.) Williamson, banker, and student of dragon flies, was as fine a type of amateur as this country has ever produced. How can we produce others like him? Of the many thousands who have used or will use the Field Book, most will touch the subject rather lightly, and be drawn from it by other interests. But some, who have that urge which can be felt but cannot be adequately explained, will go further, and some of these will become leaders in the science. The college teacher, the worker in economic entomology, and the amateur are all necessary for the progress of entomology, but it is the amateur who especially ministers to that thing we vaguely call culture, which concerns itself with the development and enjoyment of our faculties rather than the struggle for existence.

— T. D. A. Cockerell

Before the Dawn of History. By Charles R. Knight. Illustrated by the author. Whittlesey House, McGraw Hill Book Company, Inc., New York and London. $2.50.

TO A human being the most interesting subject on earth, aside from himself, is other human beings. What are we? How did we come here? What are we doing, and Why? These are questions that command our immediate attention. And this is one of the secrets of the fascination Charles R. Knight has captured and bound in with his story, between the covers of *Before the Dawn of History*.

Preëminently an artist, anatomist, painter and sculptor of animals from the life, Mr. Knight has focused his unusual talents for many years upon the portrayal of Nature as he sees it, and that he sees it with truth and sincerity is witnessed by the fact that today he stands foremost among the animal painters of his time. But not only living animals have claimed his study and work. Among his finest achievements are the series of murals in the American Museum of Natural History, showing reconstructions of prehistoric animals and man; and also a series of murals on the same subject painted for the Field Museum of Natural History. Accepted as authoritative, many of the paintings have become world-famous, and indeed, are familiar to almost every schoolboy and adult student of the history of man. These murals form the main theme of *Before the Dawn of History* and appear as a series of beautiful reproductions in brown halftone. Eight of the pictures included have never before been published.

To him who would go adventuring into the story of the past ages of the earth, and yet who is unable to see the original paintings and see them in their full beauty of color and imagery, there is no more delightful treat in store than to accept the invitation of *Before the Dawn of History* and go on an exploring expedition, with its text and its illustrations as traveling companions. I warrant he will come to the end of the book with a perspective on the history of life on this planet that will enable him to look with more understanding eyes upon the world-life of to-day, — an enlightenment that arches over the long expanse of the ages and binds together more surely day by day the innumerable fragments of evidence gathered by scientist, and artist, and thinker, throughout the years of man's history upon this earth.

On the inside front cover of the book a chart of geologic time sets the stage for the drama, and the story of the probable beginnings of the earth forms the Prologue. Then, step by step, but simply, in easily understood language, the artist-author proceeds to paint word pictures of the gradual appearance of life, as proved by fossil relics found all over the earth, from the first blue-green algae to the final masterpiece — man. Everything in its proper sequence, so that the whole panorama unrolls steadily before the mind's eye with a realism that grips the imagination to the point of making the reader feel that he is being permitted, for a brief time, to be a partaker of the actual experiences of the actors in the fight for survival and progress. One studies every detail, living the scene, and loath to go on to another, yet eager for the story.

The text throughout reveals the depth and breadth of the foundation of genius and knowledge upon which the artist was able to build so concretely. At every rereading one marvels afresh at the grasp of the subject it was necessary for him to possess before he could attempt to visualize the life of even a single age.

The experience of reconstructing these invaluable records of the living forms of ancient creatures and their surroundings must have been a remarkable one for Charles R. Knight. — A. K. Berger.

Nature Education: A Selected Bibliography. By William Gould Vinal of the School of Education, Western Reserve University, 1935. 82 pages (Mimeographed).

NO ONE knows the value and the constant need of a well-selected list of nature books better than the members of the staff of a Museum of Natural History actively engaged in nature education. Earnest requests for the names of good books on every phase of natural history are being received continually.

We have here an excellent list of eighty-two typewritten pages, prepared by one who has been engaged in the field of nature education for a quarter of a century. By his long experience as a teacher, and by his activity in camp work and other nature projects, the author is unusually well fitted to make the best selections. He himself is the author of a very helpful book, entitled *Nature Guiding*, which he has too modestly omitted from his bibliography.

The books are classified with cross references, so that it is very easy to locate the group in which one may be interested without looking through long lists.

The books are listed in nine general groups, within which are forty or fifty more specialized groups, such as — Indians, Camp Cookery, Handcraft, Plays and Pageants, Nature Poems, Dogs, Wild Flowers, — to mention only a few.

I have examined the list with some care, and find the names of very few books that I would have omitted, and I fail to find that there are many that I would like to see there. Doctor Vinal will have the gratitude of many teachers, parents, and nature leaders for this helpful booklist. — CLYDE FISHER.

Big Game Shooting in Africa. By Major H. C. Maydon. J. B. Lippincott Co., Philadelphia. 1932.

BIG Game Shooting in Africa by Major H. C. Maydon and other authorities was published by Lippincott in 1932, and hence a review at this time may seem rather tardy. However, it is a book of such importance and is so useful to the sportsman as a general or specific reference to Africa, that it deserves to be brought to the attention of those readers of NATURAL HISTORY who have not encountered it in its rather limited distribution.

The volume is divided into a series of parts which deal with general topics such as "Equipment," "Dangerous Game," and the major geographical areas typified by "Sudan," "Uganda," or "Somaliland." The parts, in turn, are treated in chapters which go into all the useful details. This treatment is intended for sportsmen who may be planning a trip to Africa, but the data are equally useful for the traveler or student who wishes to become intimate with African big game.

A number of authorities have collaborated in preparing the book, and the list of writers includes many of the very best African names. The data are brought right up to date, and no sportsman or nature lover interested in Africa who has looked into the pages of this book will want to do without it. For the department of mammals in the American Museum it is by all odds the most useful reference book in its field, and the one most often cited in answer to inquiries.

Despite the fact that the information it contains makes the volume encyclopedic in its scope, many will enjoy reading it for sheer enjoyment, as plenty of narrative is employed. Incidentally, it should, on occasion, be a boon to cross-word puzzlists, for it contains a number of native or vernacular names for mammals. No matter how "outlandish" an aggregation of letters the puzzle-maker can throw together, all too often he finds he can extricate himself by such a definition as "West African Antelopes." Many a letter and telephone message to the Museum is inspired by this pernicious habit!

The tyro is advised upon such important topics as his choice of guns and other equipment, the time of year in which to hunt, and the spot upon the animal at which to aim. Even experienced sportsmen, visiting Africa for the first time, will be glad to learn where to shoot an elephant, anatomically speaking. An elephant is a large target, but the lethal areas upon his carcass are not large, and it is well to know just where they are. He is an animal which does not respond well to experimentation along these lines, and his brain is not at all where one might think it would be.

A number of excellent photographs are included in the book. In the appendices one finds extracts from the game laws of different districts. — H. E. ANTHONY

New York Walk Book; Excursions afoot within a radius of fifty to one hundred and fifty miles of the City including forest trails in mountain regions; by Raymond H. Torrey, Frank Place and Robert L. Dickinson; new and revised edition; Dodd Mead and Company, New York. $2.50

The Art of Walking; edited by Edwin Valentine Mitchell, Loring and Mussey. $1.75

THE New York Walk Book has been written by three men who are outstandingly equipped to produce a volume that should be owned by everyone interested in New York City's out-of-door environment. The energetic triumvirate are to be heartily congratulated on their splendid accomplishment. With this book in hand, the reader will ever find a definite answer to the question, "Where shall we go walking?"

The new edition of the *Walk Book*, first issued by the American Geographical Society in 1923, is a compact, pocket-fitting volume of 332 pages. It is well indexed and has been revised to the extent that it is to all intents and purposes, a new book. Delightful pen and ink sketches, many of them panoramic profiles, are skillfully executed and help to substitute for contours missing from the colored maps.

The New York Walk Book tells, in a most satisfactory fashion, where to go, how to get there, what to see, and how to return. It is replete with well written, interesting natural history and human history information, intelligently selected and gracefully presented. There are footnotes telling of the origin of place names, the location of notable geological formations, and the significance of many historical sites. Numerous botanical and zoölogical accounts are also given. A carefully compiled bibliography enhances the value of the book.

In reading this guide, with the thought of its prospective usefulness foremost in mind, we naturally paused frequently to consider the public for whom the work is intended. We did not lose sight of the fact that there are two principal types of walkers; those with objectives in view and the ones who are objectiveless in their strolling.

We have encountered all sorts of foot travellers upon all kinds of trails. There are the ones who rush headlong through the forest, glassy-eyed, trying desperately to establish a record for the greatest number of miles covered in the shortest given time, seeing nothing and sensing less as they trot along. At the opposite end of the scale are the super-botanically-minded crawlers, who delay their companions by kneeling down every few minutes, to expound at learned length about the mosses, liverworts, or something else. Most satisfactory of all are the woods-wise individuals who combine the traits of leisurely but progressive walking with the "seeing eye."

The New York Walk Book may be safely recommended alike to the marathon runner, the all-absorbed and all-absorbing rambler, and to the man, woman, or child who "just walks."

A different sort of "Walk Book" which might well be a companion to the above, is a thoughtfully gleaned collection of tramping essays, edited by Edwin Valentine Mitchell and called *The Art of Walking*. The anthology includes the writings of George Gissing, Christopher Morley, Hilaire Belloc, Charles Dickens, William Hazlitt, J. Brooks Atkinson, Max Beerbohm, George Macauly Trevelyan, Teslie Stephens, and John Finley.

It can scarcely be claimed that all of these authors are qualified authorities on walking, nor do they claim to be. Max Beerbohm, for example, makes no bones about it when he boldly asserts, "It is a fact that not once in all my life have I gone out for a walk. I have been taken out for walks; but that is another matter. . . . When I grew up, it seemed to me that the one advantage of living in London was that nobody ever wanted me to come out for a walk." Surely here was no cross country expert!

Although a number of the collected writers are undoubtedly well versed in the manners of the trails and by-paths, — William Hazlitt and J. Brooks Atkinson are two of these, — we nevertheless believe that a better title would have been, *The Art of Writing About Walks* rather than *The Art of Walking*.

Books of this nature are remarkable for their omissions or inclusions. We fully appreciate that, in the space of 128 well designed pages, it would be an impossible task to select and reprint everyone's favorite essay on the subject of walking. Regardless of this, we do miss, rather poignantly, the works of several time-tried authors whose volumes have often accompanied us afield.

Be this as it may, *The Art of Walking* is a decidedly worthwhile book to own and, had it appeared earlier, it might well have been listed on page 320 of the *New York Walk Book* under the heading, "Nucleus For A Tramper's Library." We were surprised that both the "Nucleus" and the "Art of Walking" omitted the name of Thoreau from their pages.

John Burroughs, ever an outstanding member of the "Order of Walkers" once wrote of Thoreau, "No other writer that I recall has set forth the Gospel of Walking so eloquently and so stimulatingly."

Inasmuch as we are in sympathy with Mr. Burroughs' opinion, we are interested to note that although Thoreau's name is not to be found in the table of contents, his works are frequently referred to in the essays of several of the authors represented. Perhaps this is one of the reasons that induced Mr. Mitchell to make the omission. We might add that John Burroughs himself, and John Muir are similiarly among the missing in each book, and nowhere, in title, bibliography, or index do we find the name of that dean of walking essayists, William H. Hudson.

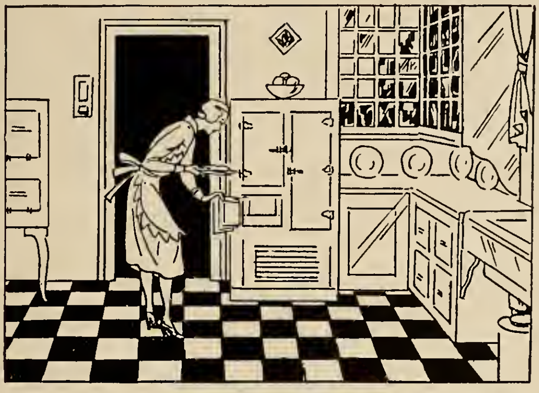
— W. H. Carr.

Recent American Museum Publications

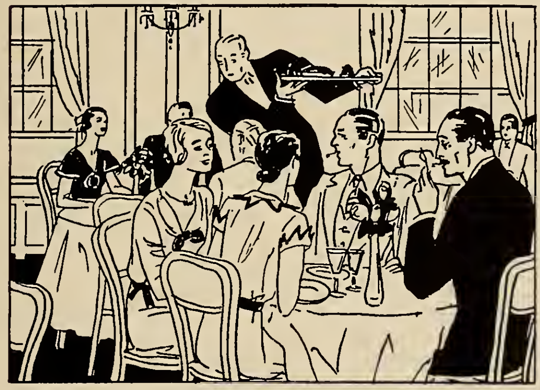
AMERICAN MUSEUM NOVITATES

No. 765. New Species of Nycteribiidae and Streblidae (Diptera). By C. H. Curran.
No. 766. New Records of Bees. By T. D. A. Cockerell.
No. 767. A New *Colias* from South Dakota (Lepidoptera: Pieridae). By Alexander B. Klots.
No. 768. Two Partially Ambicolorate Flatfishes (Heterosomata) I. — A Summer Flounder, *Paralichthys Dentatus*. II. — A Rusty Dab, *Limanda Ferruginea*. By E. W. Gudger.
No. 769. Mammals Collected in Kazakstan, Central Asia, by the Morden-Graves North Asiatic Expedition, with the Description of a New Ground Squirrel. By G. G. Goodwin.
No. 770. On a Pareiasaurian Reptile from South Africa, *Bradysaurus Whaitsi*. By Lieuwe D. Boonstra.
No. 771. On Some South African Reptiles of the Suborder Therocephalia Preserved in The American Museum of Natural History. By Lieuwe D. Boonstra.
No. 772. On the South African Gorgonopsian Reptiles Preserved in The American Museum of Natural History. By Lieuwe D. Boonstra.
No. 773. Two New Species of *Formica* from Western United States. By William Steel Creighton.
No. 774. African Bees of the Genus *Gronoceras*. By T. D. A. Cockerell.
No. 775. Early and Middle Tertiary Geology of the Gaiman Region, Chubut, Argentina. By George Gaylord Simpson.

A UNIQUE APARTMENT HOTEL COMBINATION



★ SUITES HAVE COMPLETE KITCHENS



★ FULL HOTEL SERVICE MAY BE UTILIZED AS DESIRED

Ideal East Side location just across Central Park from the Museum of Natural History; also convenient to the Metropolitan Museum of Art. Apartments of 2 to 6 rooms by the day, month, or year, furnished or unfurnished. The Croydon standards of service and equipment continue to be of the highest. Inspection of the unusually attractive model suites will be worth while. Sun roof, children's playroom, splendid restaurant.

Two rooms with kitchen and dining alcove...$125 to $250 monthly on lease, including hotel service. Rates without service are less. Accommodations for transients. Booklet N on request.

The Croydon

12 EAST 86TH STREET • NEW YORK • BUtterfield 8-4000

UNDER THE DIRECTION OF WILBUR T. EMERSON

The Philippines
and 13 other thrilling countries

WRITE YOUR OWN TICKET
ROUND THE WORLD

Beyond the broad Pacific . . . beyond Shanghai and Hongkong, across the China Sea, your President Liner makes its way into the palm-hung harbor of Manila, in the Philippines.

Manila! Have you any idea what it is like . . . this world's most hospitable city, this Spanish-American city set down in a tropical paradise?

. . .Where spreading banyans bury their long branches in the ground, and the flame trees are redder than red? Where carabao carts go snail-pace through the tree-lined thoroughfares, and honking taxis choke an old walled city's narrow streets? Where a green golf course lies in the old town's old-time moat . . . and half the houses are nipa-grass houses, raised up high on stilts.

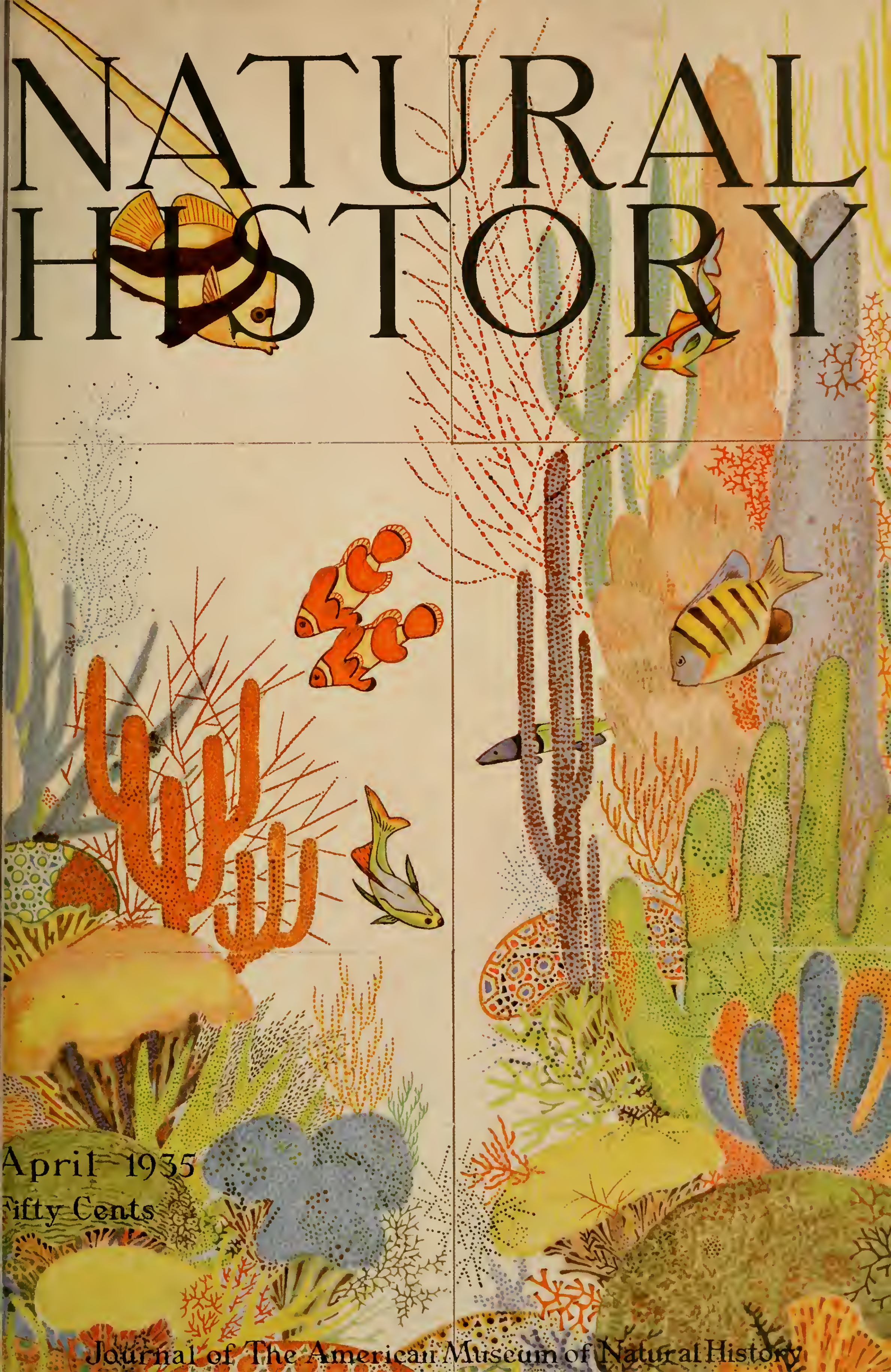
Long after every detail of a hundred other cities is forgotten you'll remember this one well. The great hotel on Manila Bay's shore, with the sparrows that lunch on the windowless dining room floor. Dewey Boulevard and the Escolta. The bamboo organ, and the great sun-dial. Women who smoke long, fat cigars, and balance their bundles on their heads. Carromatas pulled by prancing, brass-decked ponies—jingling little bells. Gay, swank clubs. Tom's Dixie Kitchen.

The Philippines will thrill you every minute of your stay. And you may stay just as long as you choose. Manila is only *one* of the 21 fascinating ports in 14 countries that President Liners visit. You may plan stopovers anywhere. Then continue on the next or a later of these liners that sail weekly from New York and California via Hawaii and the Sunshine Route, or via the Short Route from Seattle, to the Orient, thence fortnightly Round the World. You may circle the globe in 104 days, with ample time ashore. Or take up to two full years. The First Class fare is only $854!

Your travel agent will gladly help you plan your cruise, and show you pictures of accommodations (every stateroom is outside). Ask about other President Liner trips—between New York and California (westbound and eastbound), and roundtrips to the Orient. Or see any of our offices: 604 Fifth Avenue, New York; 110 So. Dearborn St., Chicago; Statler Bldg., Boston; 311 California St., San Francisco; 514 W. Sixth St., Los Angeles; Washington, D. C., Toronto, Cleveland, Seattle, Portland, San Diego, Vancouver and Victoria, B. C.

DOLLAR STEAMSHIP LINES
AMERICAN MAIL LINE

NATURAL HISTORY



April 1935

Fifty Cents

Journal of The American Museum of Natural History

BOOKS BY MUSEUM AUTHORS

for sale by THE AMERICAN MUSEUM OF NATURAL HISTORY

Akeley, Carl and Mary Jobe	
Adventures in the African Jungle	$3.00
Lions, Gorillas and Their Neighbors	2.50
Akeley, Mary Jobe	
Carl Akeley's Africa	5.00
Andrews, Roy Chapman	
Across Mongolian Plains	5.00
Ends of the Earth (1st edition 1929)	4.50
Ends of the Earth. (Star edition)	1.00
On the Trail of Ancient Man	6.00
Whale Hunting with Gun and Camera	5.00
Andrews, Roy Chapman and Yvette Borup	
Camps and Trails in China	5.00
Anthony, H. E.	
Field Book of North American Mammals	5.00
Bartlett, "Bob" Sails Over Ice	3.00
Beebe, William	
The Arcturus Adventure	7.50
Beneath Tropic Seas	3.50
Galapagos, World's End	6.00
Jungle Days	3.00
Pheasant Jungles	3.00
Half Mile Down	5.00
Beebe, William and Tee-Van, John	
Field Book of the Shore Fishes of Bermuda	3.50
Brand, A. R.	
Songs of Wild Birds. (Has two phonograph records, songs of 35 birds)	2.00
Breder, C. M., Jr.	
Field Book of Marine Fishes of the Atlantic Coast	5.00
Carr, William H.	
Glimpses of Familiar Birds	1.00
The Stir of Nature	2.50
Chapman, Frank M.	
Autobiography of a Bird-Lover	3.75
Bird-Life	4.00
Bird Studies with a Camera	3.00
Camps and Cruises of an Ornithologist	4.00
Color Key to North American Birds	4.00
Handbook of Birds of Eastern North America. 2nd Revised Edition. 1932	5.00
My Tropical Air Castle	5.00
Our Winter Birds	2.00
The Travels of Birds	.76
What Bird is That?	1.50
Clark, James L.	
Trails of the Hunted (First Edition)	4.00
Coates, C. W.	
Tropical Fishes for a Private Aquarium. (Tropical Fishes as Pets)	2.00
Curran, C. H.	
The Families and Genera of North American Diptera	7.50
Darwin, Leonard	
What is Eugenics?	.50
Ditmars, Raymond L. & Carter, Helene	
The Book of Zoography	2.00
Grant, Madison	
Passing of the Great Race	$3.50
Gray, Prentiss N.	
Records of North American Big Game	10.00
Green, Fitzhugh	
Roy Andrews — Dragon Hunter (A book for boys about Dinosaurs and Bandits)	1.75
Gregory, William King	
Our Face from Fish to Man	5.00
Man's Place Among the Anthropoids	2.50
Haring, H. A.	
The Slabsides Book of John Burroughs	2.50
Johnson, Martin	
Cannibal-Land	1.00
Lion	5.00
Safari	5.00
Johnson, Osa Helen	
Jungle Babies	1.75
Karazin, N.	
Cranes Flying South	2.50
Kunz, George F.	
The Magic of Jewels and Charms	8.50
Rings for the Finger	8.50
Lederer, N.	
Tropical Fish and their Care	2.50
Leigh, W. R.	
The Western Pony	10.00
LaMonte, Francesca and Welch, Micaela	
Vanishing Wilderness	2.50
Lorimer, Frank and Osborn, Frederick	
Dynamics of Population	4.00
Lutz, Frank E.	
Field Book of Insects	3.50
McCreery, James Lindsay	
Exploring the Earth and Its Life	2.00
McSpadden, J. Walker	
To the Ends of the World and Back. Scouting for a great Museum (The American Museum of Natural History)	3.00
Mann, Paul B., and Hastings, Geo. T.	
Out of Doors. A Guide to Nature	2.00
Mason, Gregory	
Columbus Came Late	4.00
Mead, Margaret	
Coming of Age in Samoa	3.00
Growing Up in New Guinea	3.50
The Changing Culture of an Indian Tribe	4.50
Medsger, Oliver P.	
Nature Rambles *Spring*	2.00
" " *Summer*	2.00
" " *Autumn*	2.00
" " *Winter*	2.00
Morden, William J.	
Across Asia's Snows and Deserts	5.00
Murphy, Robert Cushman	
Bird Islands of Peru	6.00
Nichols, J. T. and Breder, C. M., Jr.	
The Marine Fishes of New York and Southern New England	$1.40
Noble, G. Kingsley	
The Biology of the Amphibia	5.00
Osborn, Henry Fairfield	
Cope: Master Naturalist	5.00
Evolution of Mammalian Molar Teeth	2.75
Creative Education in School, College, University and Museum	2.50
The Earth Speaks to Bryan	1.00
Evolution and Religion in Education	2.00
Fifty-Two Years of Research, Observation and Publication, 1877–1929	1.50
From the Greeks to Darwin	2.50
Impressions of Great Naturalists	2.50
Man Rises to Parnassus. 2nd Edition	3.00
Men of the Old Stone Age. 3rd Edition	5.00
The Origin and Evolution of Life	4.00
Reeds, Chester A.	
The Earth. Our Ever-Changing Planet	1.25
Schwesinger, Gladys C.	
Heredity and Environment	4.00
Simpson, George Gaylord	
American Mesozoic Mammalia	5.00
Attending Marvels. A Patagonian Journal	3.00
Stefansson, V.	
My Life with the Eskimos — New and Abridged Edition	2.50
The Friendly Arctic	6.50
Vanderbilt, William K.	
Across the Atlantic with *Ara*. Summer 1924	5.00
15,000 Miles Cruise with *Ara*. 1927	5.00
Taking One's Own Ship Around the World	30.00
To Galapagos on the *Ara*	30.00
West Made East with the Loss of a Day	20.00
Walker, Edith B. and Mook, Chas. C.	
Tales of the First Animals	1.50
Wissler, Clark	
The American Indian	5.00
Introduction to Social Anthropology	3.50
Man and Culture	2.75
Relation of Nature to Man in Aboriginal America	3.50
Boy Scout Book of True Adventure	2.50
The Earth, the Seas and the Heavens. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00
Fishes, Insects and Reptiles. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00
Mammals and Birds. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00

Address orders to The Librarian

THE AMERICAN MUSEUM OF NATURAL HISTORY
77th STREET AND CENTRAL PARK WEST :: :: :: NEW YORK, N. Y.

Remittances must accompany all orders — Include 10 cents per volume for postage

NATURAL HISTORY

The Journal of the American Museum of Natural History

CONTENTS

VOLUME XXXV, No. 4 APRIL, 1935

A Submarine Design in Tiles . . . . *Cover*
By W. H. Southwick

Aristocrats of Abyssinia . . . . *Frontispiece*

Transplanting a Coral Reef . . . . Roy Waldo Miner 273
A Description of the Bahaman Coral Reef Group Soon to Be Opened at the American Museum

The Ethiopians and Their Stronghold . . . . Wilfred H. Osgood 286
The People of Abyssinia and the Rich and Varied Land They Inhabit

José . . . . Frank M. Chapman 299
Two Months from the Life of a Barro Colorado Coati

In Quest of the Giant Panda . . . . Dean Sage, Jr. 309
An Account Describing the Work of the Sage West China Expedition near the Borders of Tibet

Streamlining — Old and New . . . . Harold Ward 321
A Principle Long Practiced by Nature, which Man Has only Recently Begun to Study

Nesting Days . . . . Alfred M. Bailey 331
With the Return of Spring the Bird World Reawakens

Building a Super-Giant Rhinoceros . . . . William K. Gregory 340
The Problems Encountered in Reconstructing the Skeleton of Baluchitherium

Trailside "Talking" Pools . . . . William H. Carr 344
How a Stream and a Series of Pools Have Been Made to Tell Their Own Stories

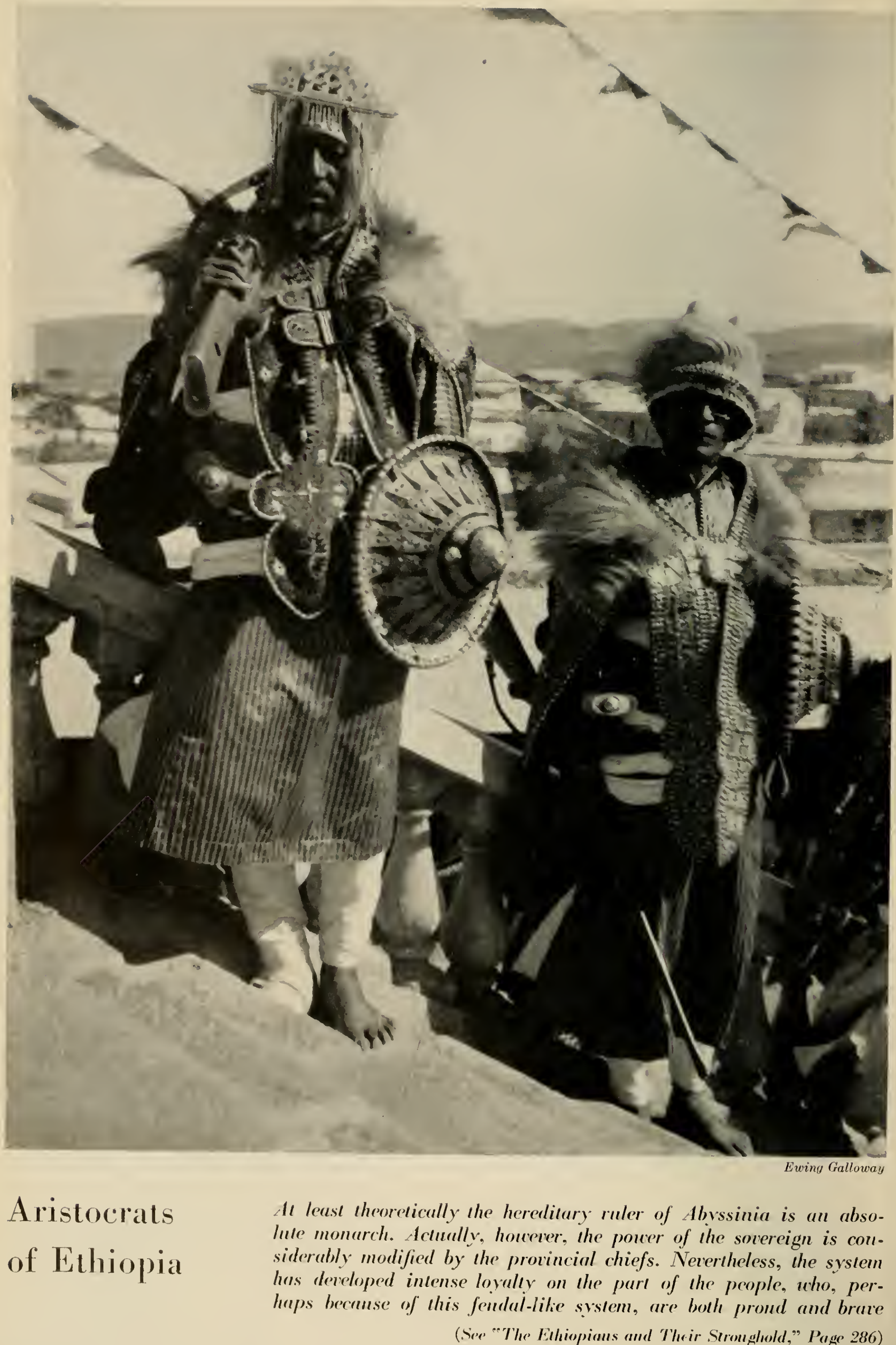
Science in the Field and in the Laboratory 352
Current Events in the World of Natural Sciences

Reviews of New Books 359
Recent Publications for Those Interested in Nature

HAWTHORNE DANIEL
Editor

A. KATHERINE BERGER
Associate Editor

NATURAL HISTORY — Publication Office, 10 Ferry Street, Concord, New Hampshire
Subscriptions should be addressed to 10 Ferry Street, Concord, N. H., or to The Treasurer, The American Museum of Natural History, 77th Street and Central Park West, New York, N. Y. NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership, $2.10 of the annual amount received from each membership being in payment of the year's subscription to the magazine. TOM DAVIN, Manager of Publications, Advertising Office, The American Museum of Natural History, 77th Street and Central Park West, New York, N. Y. Copyright, 1935, by The American Museum of Natural History, New York



Ewing Galloway

Aristocrats of Ethiopia

At least theoretically the hereditary ruler of Abyssinia is an absolute monarch. Actually, however, the power of the sovereign is considerably modified by the provincial chiefs. Nevertheless, the system has developed intense loyalty on the part of the people, who, perhaps because of this feudal-like system, are both proud and brave

(See "The Ethiopians and Their Stronghold," Page 286)

NATURAL
HISTORY
April, 1935

Transplanting a Coral Reef

A description of the beautiful Bahaman Coral Reef Group soon to be opened at the American Museum

BY ROY WALDO MINER
Curator, Living Invertebrates, American Museum

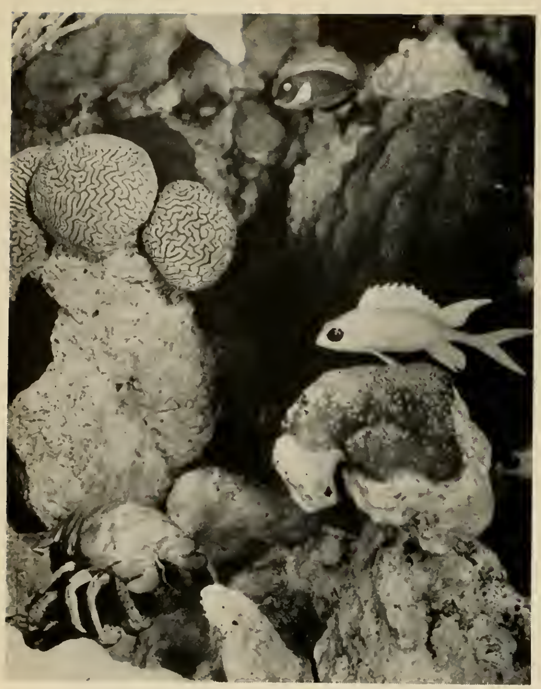
After twelve years of complicated and difficult work, the department of living invertebrates at the American Museum is about to open to the public what is, perhaps, the most remarkable museum "group" ever constructed. Created from forty tons of coral that was gathered from the sea bottom in the Bahamas, this elaborate exhibit is tied together and supported by an intricate fabric of structural steel which, in itself, weighs eight tons. In the course of the work, Doctor Miner, the author of the following article and the originator and designer of the exhibit, has led five expeditions to the Bahamas during which the studies and the collections utilized in building the group have been made. His account and description, therefore, are of special interest and value. — THE EDITORS

AS you enter the Hall of Ocean Life on the gallery level at the American Museum, the new Bahaman Coral Reef Group may be seen at the farther end directly opposite the observer. Its proscenium arch rises from the main floor of the hall, passes through the gallery, and surrounds the upper part of the group in a half-circle at a height of thirty-five feet.

The portion of the group above the gallery presents a vista of coral island with waving palm trees, quiet lagoon, and tropical sky with trade-wind clouds drifting across it. A flight of flamingos dots the background of snowy clouds with flecks of rosy color. On the distant horizon, apparently a mile or so away, the low-lying shore of Andros is visible, soft with its long fringe of coconut palms. For the scene is laid in the Bahamas, along the eastern coast of its largest island mass, where the finest coral barrier reef in the West Indies parallels the shore. The small island in the foreground is Goat Cay, just back of the main reef, the location of which, at the left, may be seen more clearly, at closer view.

The section of the group below the gallery, even at this distance, obviously depicts the coral forest as seen from the bottom of the sea. On either side, staircases permit visitors to descend from the gallery, and, as it were, plunge beneath the waves to stand on the ocean floor and study the coral reef from that point of vantage, as the members of the Museum's expeditions did in obtaining the material and observations for this group.

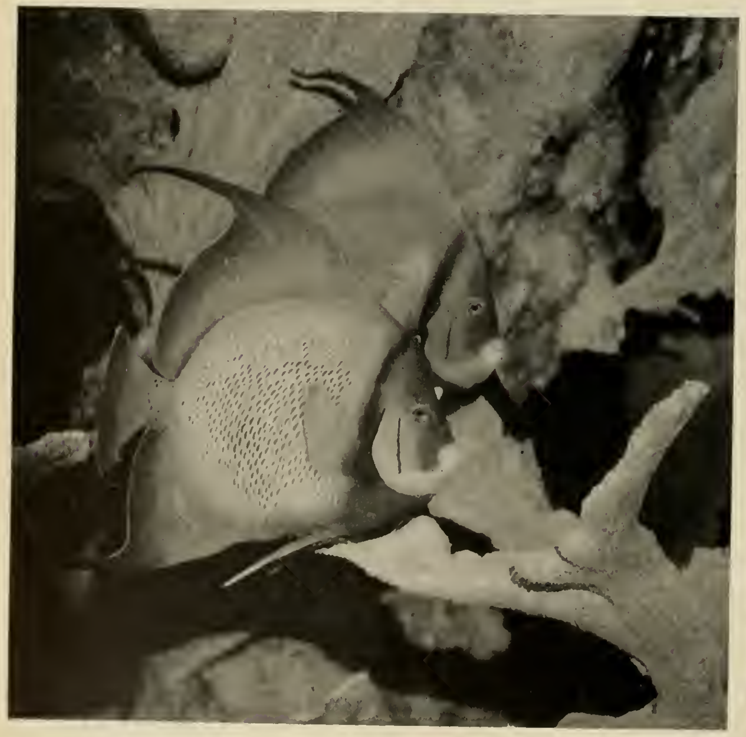
Now let us pass around the gallery and view the upper scene at close range. We are looking over the rail of a yacht which has been anchored fore and aft in a channel of the reef. The wind-swept vegetation of Goat Cay and its shore of eroded limestone are now clearly visible. At the left, the dark blue waters of the Tongue of the Ocean, an arm of the sea more than a mile in depth, roll in, breaking heavily upon the barrier reef in long lines of white foam. The coral barrier rising from the crest of a submerged precipice, the summit of which is from twenty to forty feet below the water surface, consists largely of huge branching



(Above) The Cave of the Blue Parrotfish guarded by its white-jawed denizens

A squirrel-fish swims over a post of orb coral toward a triple-headed brain coral, below which crawls a bear-crab

(Below) Two members of a school of black angel fish, with spadelike bodies, their dorsal fins with trailing filaments



A spiny lobster peers forth from its den among the corals, waving its prickly antennæ

A vista through branching elkhorn corals. Black angel fish swim by in stately procession. In the foreground is a group of three mushroom-like orb corals

trees of the elkhorn coral, the tips of which break the water surface at low tide. The trade winds, blowing continuously from the southeast, dash the waters of the Tongue of the Ocean against the face of the submarine precipice and the tangled growth of the stony coral trees, causing upwelling currents which mingle with the ranks of snowy-crested surf.

THE UPPER SCENE

Inside the reef the force of the waves is broken, and they slide with diminishing force in intersecting cross currents across the quiet waters of the sheltered lagoon, where vessels may lie safely at anchor, except in times of hurricane.

In the distance the shore of Andros shows native villages snuggling among the coconuts, while, at the right, the open waters of a wide strait, Middle Bight, lead the eye into the quiet peace of a broad inland sea, dotted with islands.

The towering trade-wind clouds rise on the heated air currents of a June day 25,000 feet into the air, where their fleecy summits stand out against the deep blue of the tropic sky. Outlined against them, the long file of scarlet flamingos flies in stately procession inland to follow the coast to the great flamingo colony in southern Andros.

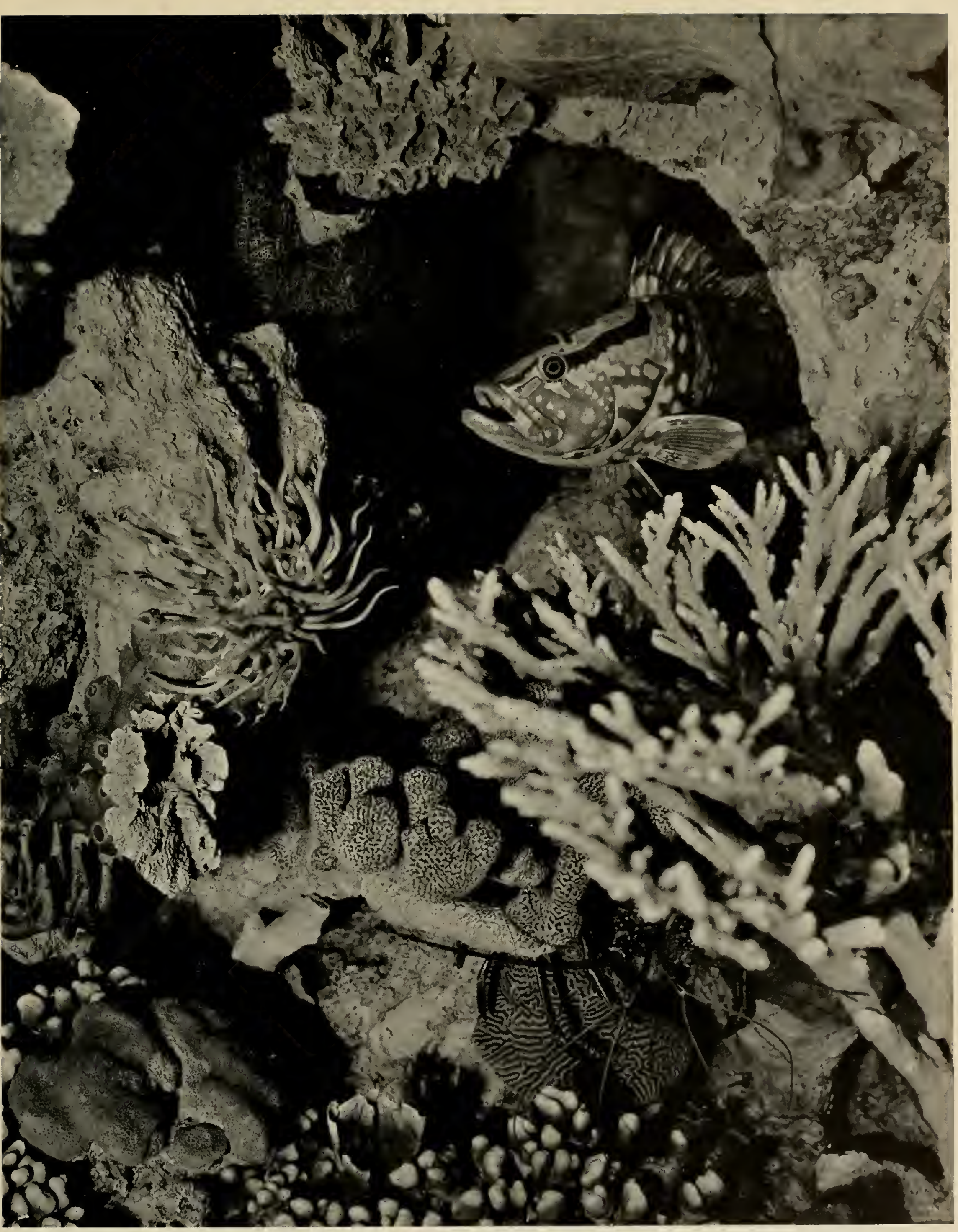
Our boat is anchored close to a little rocky cay, a point of which projects in the right foreground, carved and honeycombed in fantastic hollows.

Looking over the rail, our eyes penetrate the transparent waters right down to the bottom of the sea, and, through their lucid depths the wondrous submarine gardens are disclosed with all their beauty of form and color, tempting us to a closer view.

So, descending the staircase, we pass beneath the gallery level, and well may we imagine that we have donned diving helmets and have penetrated the depths, for all the glory of the coral world bursts upon the view. We are gazing into the heart of a magnificent coral forest. The branching trees of the elkhorn coral (*Acropora palmata*) rise, tier on tier, above our heads, breaking the water-surface sixteen feet above. An arching sea cave at the right, piercing a fantastically carved and eroded submarine ledge, leads into a tortuous tunnel filled with mysterious purple shadows and soft lights filtering through an opening in the rear. This is the Cave of the Blue Parrot-fishes, and two of the heavy-bodied cerulean tenants may be seen nosing their way out of the cavern entrance, while a third swims slowly back and forth as if guarding the back door.

Between the rocky wall and the spreading tangle of the coral forest a vista opens out into the watery world, melting by degrees into the opalescent and luminous blue mist which everywhere terminates our vision in the distance. The light of the sun filters through the aqueous depths, lighting up vague forms of grotesque outline. The waters in the Bahamas are of unbelievable transparency. Crystal clear in the foreground, everything stands out as sharply as in the open air. Under favorable circumstances, at depths ranging from fifteen to twenty-five feet, one can see a hundred feet or more before visual penetration is limited by the gathering density of the sun-lit azure fog.

The sea floor, around one's feet, blooms with every variety of stony splendor in crowded array. Not an inch is wasted. As far as the eye can see through the watery aisles the abundant coral growths stand in shouldering clusters. Here is a group of three green, dome-shaped caps rising close together on stony pedestals for all the world like giant mushrooms. They are the annular orb corals (*Orbicella annularis*), their green summits suffused with delicate clouds of rose, where areas of the tiny flower-like polyps show their expanded tentacles. Near by, a double-ridged brain coral (*Diploria cerebriformis*), bright orange in color, projects its rounded knoblike head, mounted on a contorted column, its surface covered with complicated meandering sculpture, suggesting the convolutions of the human brain. A little farther to the left another growth of the same species has developed an odd triple cluster of heads upon the same stem. A beautiful elkhorn immediately behind it spreads an unusually symmetrical frond of broad palmate branches like a giant fan. Crowding upon this from the rear, phalanxes of orb coral



Nassau

Grouper

This great, striped and mottled fish is often so camouflaged among its surroundings as to be practically invisible. Should it swim over a patch of white sand, its colors fade to harmonize. Opposite the grouper a giant sea anemone spreads its waving tentacles. At the lower right is a fragile bush coral posts stand, grouped like sentinels, among golden yellow nuggets of pore corals (*Porites astreoides*) which cover every available space on the sea floor between their stately neighbors.

In the center foreground, spreading clusters of the fragile, finely divided bush coral (*Acropora prolifera*) overarch the hiding place of the spiny lobster or crawfish (*Panulirus argus*), while on a little sandy patch at the lower left a bear-crab (*Scyllarides æquinoctialis*) is warily inspecting a large spiny sea urchin (*Centrechinus antillarum*) which radiates its black, needle-like spines in all directions, reminding one of a submarine porcupine. Clusters of yellow-tipped finger corals (*Porites clavaria*) are crowded at the base of a great dome of sidereal coral (*Siderastrea siderea*), most massive of all species. This particular specimen weighs a ton and a half, and, when collected, required the combined efforts of twelve men to roll it up the beach.

THE LAIR OF THE MORAY

Behind the finger corals arches a low cavern, the home of the dreaded green moray (*Gymnothorax funebris*), which inhabits crevices of this sort. It is a heavy-bodied eel with small head furnished with sharp, needle-like teeth. It is well for a diver not to thrust hand or foot into such a crevice without first investigating with a lance, for the creature will dart out its head, biting viciously at any intruder. The eroded coral forming the arch and sides of this cavern is overgrown with purple, green, and yellow sponges, some forming clusters of chimneys, others made up of low, rounded mounds crowded closely together.

Everywhere among the stony coral structures rise dense growths of gorgonians. These are the plantlike sea-bushes, sea whips, sea feathers, and sea fans. When one observes them through a glass-bottomed boat, one can see them wave back and forth with the ocean currents, and they are often mistaken for vegetation by the casual observer. Nevertheless, they are animal structures with a core built of horny material, instead of having a limy "skeleton," as with the reef-building corals. There are some gorgonians, known as "sea clubs," with fully expanded polyps, shown in the group near the moray's den. The clubs are purple, but, when the light-green polyps are fully expanded, that color is concealed and the clusters appear to be masses of heavy, feathery plumes. When one touches them, however, the green polyps are suddenly withdrawn within the clubs, and the color seems to change into purple as if by magic.

The sea feathers (*Gorgonia acerosa*) are large, heavy, magenta-purple plumes reminding one of ostrich feathers. Many of them can be seen in the group. When fully expanded, the fine branchlets are covered with rows of tiny corn-yellow polyps suggesting the florets of goldenrod.

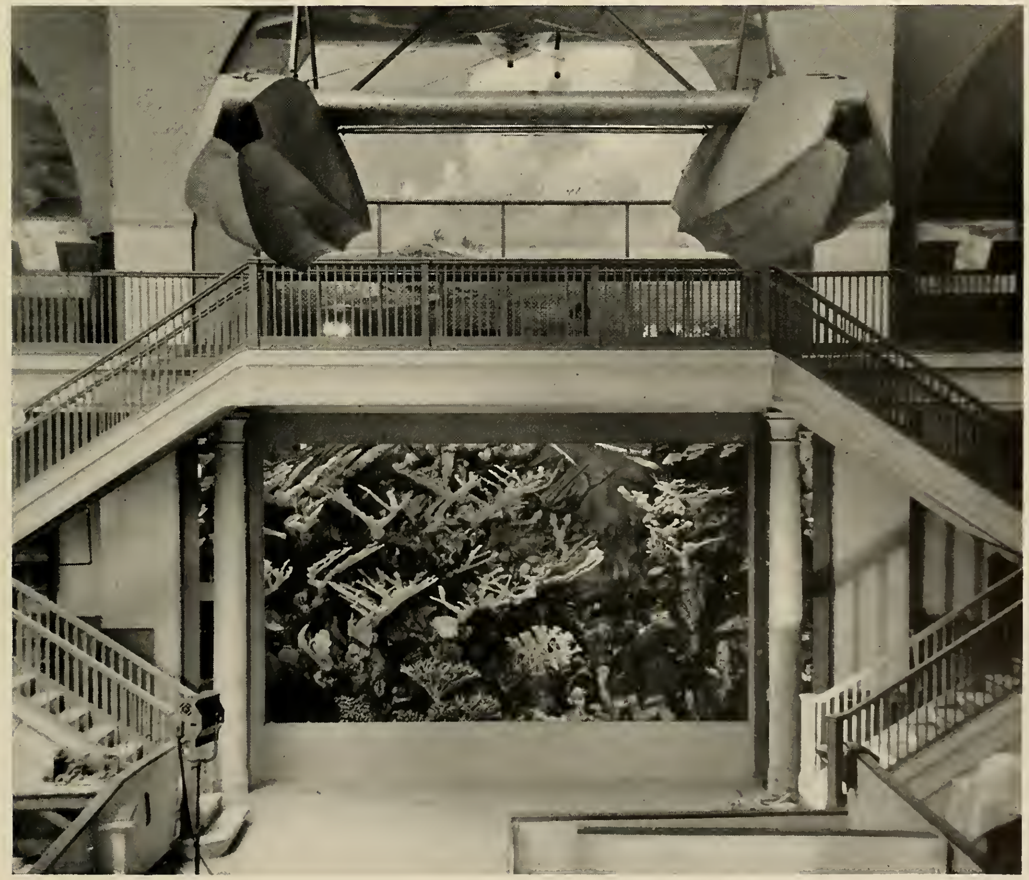
The sea fans (*Gorgonia flabellum*) are strikingly conspicuous on the reef. As their name implies, they are broad fanlike expansions, characterized by a lacy texture of fine meshes. Purple and yellow sea fans are seen growing side by side and are of the same species.

The fish-life of the coral reef is very abundant and characteristic. When, equipped with diving helmets, we wandered, half walking, half gliding, through the coral forests of Andros, or the sea gardens of Rose Island, we seemed to be in another planet, where trees were of tinted marble and grew with interlacing branches gnarled in weird contortions from a forest floor beset with enormous mushrooms, also of stone; where animal flowers expanded and contracted on every hand, and dim figures moved silently in dark, mysterious caverns. We ourselves glided almost as in a dream, for, though we wore helmets weighing sixty-five pounds in the world above, down here among the corals we seemed to have lost all weight, and, borne up by the aqueous medium, became part and parcel of our ethereal environment.

Then, suddenly, almost out from nothingness, our watery atmosphere became shot with living jewels, brilliant colors scintillated in the sunlight that came dancing down from the motile liquid silver film of the water surface above. Fishes of every hue were all about us. Chromids shone with sapphire, blueheads, — the males, true to their name, hooded with rich azure, col-

Transplanters of the Coral Reef. Doctor Miner conversing with Chris Olsen, chief modeler of the group. At left, Herman Mueller, glass modeler, Dr. George Childs, scientific artist; at right, Worthington Southwick, colorist, Bruce Brunner, assistant modeler

General view of the Coral Reef Group seen beneath the pontoons of the Lindbergh plane. (Above) the Coral Lagoon at Andros Island. (Below) view into the heart of the coral barrier from the sea floor



lared with black and snowy white, with bodies of a brilliant emerald-green; the females, with salmon-colored cheeks, their bodies green and white, with black stripes; the young, yellow like canary birds, often variegated with black blotches and areas of green and pink. As we wandered about, larger species sailed into view, gaudily decked out in gay patterns.

FISHES OF THE CORAL REEF

Let us return to our group, for here we have endeavored to give a similitude of life as faithfully as possible, though with a feeling of despair at the inadequacy of our efforts.

Many blueheads (*Thalassoma bifasciatum*), as described above, may be seen flitting about in various parts of the group, especially toward the right. The sergeant-majors or cock-eye pilots (*Abudefduf marginatus*), are the rather deep-bodied little fishes, with vertical black bars over a body shading from yellow to white, in the upper right-hand corner, near the top of the rocky ledge. They must not be confused with the banded butterfly-fishes (*Chætodon striatus*). These are thin, flat, and much smaller. They are seen as if flitting like butterflies, in the lower part of the group, to the right of the center, where they are associated with blueheads and slippery dicks (*Iridio bivittata*). These latter are little, elongate fishes, with a continuous fin along the back, their color blending through pale tints of rose, green, blue, and black markings on an orange and yellow ground.

The large fishes swimming in a school down past the upper portion of the cliff are yellowtails (*Ocyurus chrysurus*), so-called because they have a bright yellow stripe along the side of the body continued into a completely yellow tail. They are excellent foodfishes and are eaten throughout the West Indies.

An interesting situation is occurring in the upper part of the group. A school of houndfishes (*Tylosurus raphidoma*), conspicuous because of their slender, silvery bodies and long pointed beaks, is being broken up, the fishes scattering desperately through the coral branches. The reason is not far to seek. Lurking just under the water-surface, at the upper left, and gliding through the coral branches, is a large barracuda (*Sphyræna barracuda*), four and one-half feet in length. Its baleful eyes are fixed on its prey as it slides swiftly toward them, the undershot jaw slightly open, showing an irregular assortment of long, cruel teeth. The barracuda are abundant in tropical waters, where they are dreaded even more than sharks. Fortunately, they seem to prefer open lagoons, and only occasionally visit the reefs.

In the middle distance, below the houndfishes, a large school of black angel fishes (*Pomacanthus arcuatus*) sails slowly by in stately procession. They are deep-bodied, dark gray in color, often with indefinite vertical bands, and with trailing filaments prolonging their large, flat, dorsal and anal fins. Compare them with the blue angel (*Angelichthys ciliaris*), a brilliantly blue, flat-bodied fish, in the middle part of the group, nibbling at a purple sea feather. The remarkable peacock blue of its body and fins is narrowly bordered with scarlet which shades into trailing, bright yellow filaments above and below. Near by, a school of yellow and black rock beauties (*Holacanthus tricolor*) flits in and out among the corals.

NATURE'S CAMOUFLAGE

Slightly to the left of the lower center, just behind a growth of the fragile bush coral, a large Nassau grouper has emerged halfway from under a coral arch. Its brown-and-tan striped and mottled color pattern acts as a camouflage with the variegated surroundings and so completely conceals it that one can gaze directly toward the fish for several minutes without noticing it, in spite of its size. The Nassau grouper is one of the prized foodfishes of the Bahamas, and the people of Nassau pride themselves on the savory chowders made from it. When exploring a reef with diving helmet, one should be wary of cornering one of these groupers, for when irritated, they are capable of suddenly turning and giving a vigorous nip. It is interesting to watch a grouper swim out over a patch of white sand. As it does so, the mottled color pattern fades out before one's eyes and the fish becomes pale and sandy in color, completely harmonizing with its background. As it turns and goes into the reef again the color pattern returns with all its original vividness.

Around the grouper's arched hiding place, several clumps of the beautiful lettuce coral (*Agaricia agaricites*) are attached to the dead coral rock. They have beautifully foliated expansions in undulating clusters, richly tinted with rose-madder, pink, and purplish-blue, often with suggestions of yellow. On one of our trips, our artists made careful color sketches of these corals in the living state. Then the specimens were collected, bleached, and brought back to the Museum, where the color was restored artificially in oils. On a subsequent expedition, we carried samples of these painted corals back with us, took them down undersea, and placed them on the reef, beside living specimens. We were greatly gratified to find that the artists had copied the colors so faithfully that they could not be told apart when viewed at arm's length.

CORAL GARDENS

Almost directly opposite the nose of the grouper, a beautiful red-tipped sea anemone (*Condylactis gigantea*) of large size expands its cream-colored, petal-like tentacles above a scarlet body. The sea anemones are closely related to coral polyps, but, unlike them, are incapable of building a stony skeleton.

At the extreme right of the group, a series of great domelike heads of brain coral (*Mœandra*) and purple sidereal coral (*Siderastrea*) rise in a clustered terrace of massive outline. Among them tower post-like pinnacles of tree-stump coral (*Dendrogyra cylindrus*), with meandriform patterns completely covering their shafts. Butterfly fishes flutter about, their light delicacy in strong contrast to the massive rotundity of the coral heads.

The loosely branching antlers of staghorn coral (*Acropora cervicornis*) grow out from the narrow crevices between the heads, their sharp points menacing like *chevaux-de-frise*. Immediately before one's eyes, the striking color pattern and unbelievable form of the queen trigger fish (*Balistes vetula*) startle the gaze of the onlooker. Various individuals are differently colored, but all are equally surprising.

STARTLING COLOR COMBINATIONS

The most brilliant combination starts with velvety bright green on the upper part, shading into equally bright purple below. The lower part of the face may be pink or yellow, and two extraordinarily brilliant blue streaks are slashed across the face. Radiating irregular lines of black outlined with cream dart in all directions like lightning streaks from the very bright eyes with their little, black, beadlike pupils. The body of the fish is so narrow that when it turns toward you it seems almost to disappear. Its little, absurdly puckered mouth is furnished with white, close-set teeth. The fish is not shy, but will swim directly up to your helmet and peer in at you, moving its pursed up mouth as if it were trying to kiss you. If you try to grab at it with your hands you find it always just beyond your grasp.

Above it is another surprise, — a fish that we often see nosing about the reef, always singly. It is the equally absurd trumpet fish (*Aulostomus maculatus*). It grows to a yard or more in length, and is equipped with a ridiculous elongated snout, flattened vertically with a small mouth at the extreme end which is always in motion. It has a pulled-out caricature of a horselike face with small eyes set far back. The paired fins are very small, — almost insignificant, but the vertical dorsal and anal fins are broad and set so far back on the body as to seem about to slide off on to the fan-shaped almost arrow-headed tail. The color-pattern is quite as surprising. It is faintly suggestive of a Scotch plaid, being composed of vertical brown bands crossing longitudinal yellow stripes at right angles, against a light tan background. Small black dots are sprinkled over this array in longitudinal rows. As the fish progresses, it may expand its mouth like a trumpet, or the whole snout will droop in elephantine fashion. Sometimes it swims nearly upright, with head either up or down.

It is refreshing to turn from this out-

(Left) The weird trumpet fish, with its elongate, extensible snout and Zeppelin-like body, floats slowly through a school of spotted hinds

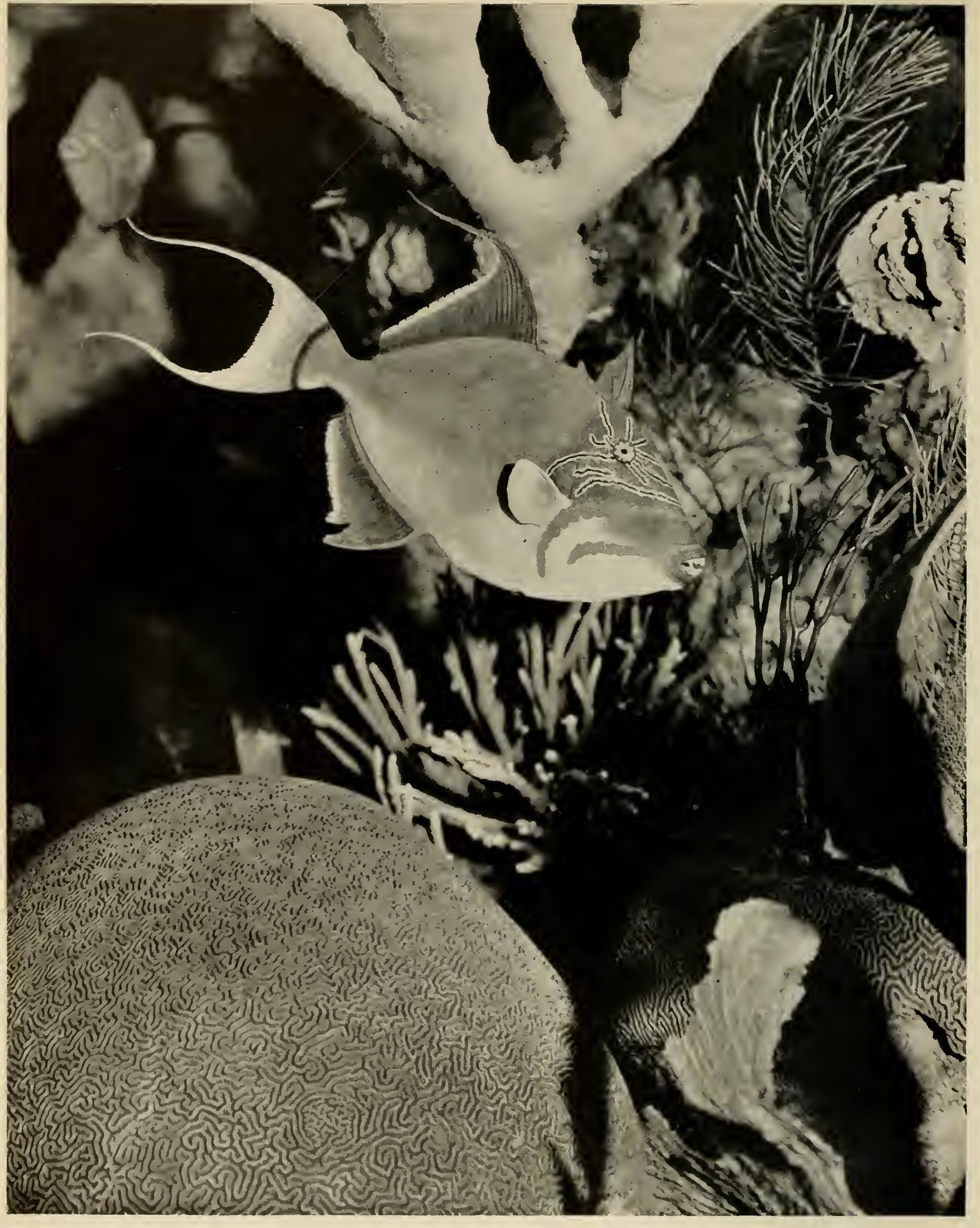
(Below) A cluster of tube-building marine worms expands purple, flower-like heads on the side of an eroded coral pedestal

(Above) Gnarled, interlacing branches of the elkhorn coral form dense forests of stone trees rising to the water surface from the sea floor

(Below) A gray snapper (upper left) darts down among the smaller blueheads. A blue-striped grunt swims in from the right

A green moray lurks within an arched cavern, ready to attack any passing creature with its array of needle-sharp teeth

(Below) Around a fanlike elkhorn flit banded butterfly fish, slippery dicks, female and young blueheads. A surgeon fish swims below them



Queen

Trigger

Fish

Its striking colors and unbelievable form startle the observer. Bright green blends into equally bright purple. Part of the face is yellow, slashed by blue lines of the utmost brilliancy. Lightning-like streaks of black and yellow radiate from the eyes landish affair to the school of more normal looking rock hinds (*Epinephalus adscensionis*) swimming near and above it, their bodies patterned with reddish, oval spots.

The trumpet fish is headed toward a growth of sea feathers. Let us look in the same direction downward to the right and behind the beautifully symmetrical growth of elkhorn coral with the clustered sea fans at its base. Peering in here carefully, we see two huge, rainbow parrot-fishes (*Pseudoscarus guacamaia*) lurking in the shadows. Their name is quite appropriate, for they have conspicuous blue teeth, continuing the shape of the head in parrot-like profile. The scales of the hinder portion of the body are green edged with brown, while the forward part is of variable reddish brown. Let us compare them with the blue parrot-fish (*Scarus cœruleus*), in the cave at the extreme right of the group. These fish are uniformly blue, though in some individuals this may shade into dark indigo.

The conspicuous teeth are white and are very powerful grinders. I have watched these creatures through the windows of my helmet, as they swam out of their cavern and nosed about the rocky surface flanking it. They would actually bite off pieces of the limestone, grind them between their powerful teeth, presumably to get at the boring worms, sponges, and other nutriment permeating the porous substratum. After the rock was ground to powder, they would eject it from their mouths, and I could see the clouds of pulverized limestone rising toward the surface.

A school of gray snappers (*Lutianus griseus*) edges out of the lower part of the cave below the blue parrots and turns to the right where blue tangs or surgeon fish (*Acanthurus cœruleus*) are circling uncertainly. These are vertically flattened fishes, rounded in outline. Their color is a chocolate-brown with fine blue lines running through it. The edge of the dorsal fin is lined with blue. Their name is derived from the sharp curved lancet on either side of the peduncle of the tail. This may be erected and will lacerate the hand to such an extent that there would be no doubt about its capacity for blood-letting.

Blue-striped grunts (*Hæmulon sciurus*) are swimming out from the extreme lower right of the group, past posts of *Dendrogyra* coral, their flat-nosed bodies adorned with a striking pattern of narrow, alternating blue and yellow stripes. The blue lines often gleam as the fish turns in the sunlight, so as to appear almost iridescent. Above the ledge where they are swimming is an obliquely sloping shelf capped with encrusting green brain coral (*Mœandra viridis*), from which a small forest of gorgonian sea bushes is growing, partly obscuring the entrance to the Cavern of the Blue Parrot-fishes. A closely packed school of spotted hinds (*Epinephalus guttatus*) swims downward past the clump, keeping in ordered phalanx as though it were perilous to direct their course past the den of the larger fish.

A MARINE KALEIDOSCOPE

Before we turn away from the group, our eyes catch a flash of color, and we stoop to examine at close range a squadron of squirrel-fishes (*Holocentrus ascensionis*) sliding past in front of the cluster of mushroom-like orb corals already mentioned. These little fishes are brilliant scarlet in color with darker stripes running the length of their body. Their huge, dark-red eyes seem out of all proportion to their size.

These are only a few of the multitudinous fishes ordinarily associated with a Bahaman coral reef. The entire number of species recorded from the Bahamas mounts up to more than a thousand. The Coral Reef Group is carefully planned to display a balanced association of reef-life, occurring at a definite locality, with the number of species likely to be noticed readily during an average trip to the sea bottom if one were observant and had time to take stock of his surroundings. It must be remembered that the scene would be changing constantly, and the observations of successive visits to the same locality would never be identical. Then, as we moved from place to place along the same reef, every location would be different from the rest. The character and arrangements of the coral growths and associated forms would change kaleidoscopically, one factor becoming dominant in a given region, while in another place it would be of secondary importance.

The Ethiopians and Their Stronghold

The people of Abyssinia and the rich and varied region they inhabit in the African highlands

Photographs by the Author and Alfred M. Bailey

By Wilfred H. Osgood

Curator, Department of Zoology, Field Museum of Natural History

THE country now called Ethiopia, but better known as Abyssinia, has a long, interesting history and there are many reasons why it remains independent of European control. It is situated a few degrees north of the Equator and slightly inland from the mouth of the Red Sea. The French port of Djibouti, with which its capital is connected by rail, lies directly in the path of round-the-world travel, so it is no longer inaccessible.

It has an area nearly a third larger than England, France, and Italy combined. Its uncounted population is no less than five millions and may be as many as ten. These millions, who are not Negroes but are brown-skinned people of northern derivation, have long been isolated from the modern world and are still living practically as they did hundreds or even thousands of years ago. The greater part of the country is fertile highland, wooded and watered, and it is blessed with a glorious and healthful climate. Unquestionably it is the finest piece of unappropriated real estate on the international horizon.

A few years ago, on returning from a lengthy zoölogical expedition to this country, I referred to it as "The Tibet of Africa." This seemed justified by its independence and isolation, its rugged highland territory, its religious peculiarities, and the prevailing tales of mystery about it. Although these comparisons still hold, conditions are changing rapidly and, as events seem to be forming, it may soon be more appropriate to take another Asiatic source of analogy and call Ethiopia "The Manchuria of Africa." In other words, the old Biblical query "Can the Ethiopian change his skin?" may need revision to "Can the Ethiopian *keep* his skin?"

The answer to this question perhaps should come from experts in colonial history and international relations. Any judgment, however, must take into account the history and character of the people, the physical and climatic conditions under which they live, and the resources they have at their command. During the years in which the country was practically a closed territory, it was natural that many wild stories and misconceptions should circulate. Some of these were sufficiently sensational to be easily exaggerated and the reports of border clashes were often highly colored. It was said that the Ethiopians tortured and mutilated their prisoners, that they cut off the hands and feet of their own offenders, that they killed and scalped men as a prerequisite to marriage, that they kept slaves and cruelly mistreated them and, worst of all, that they actually fed on raw meat! Could there be any doubt, then, that they were savage barbarians unworthy of respect or consideration?

Some of the accusations against them have at least partial foundation in fact but, actually, the Ethiopians of today are a mixed people of whom the ruling class and a large percentage of the entire population are no more savages than were our own ancestors, in western Europe, during the Middle Ages. In the present world they are anachronisms, but this probably is due less to inherent qualities than to their long isolation and their devotion to a religion which is essentially the same as our own. They trace themselves back to the dawn of history and during thousands of years their original stock has been subject to infiltrations from various directions. Today, they show effects of mixture with Egyptian, Arab, Israelite, and Negro.

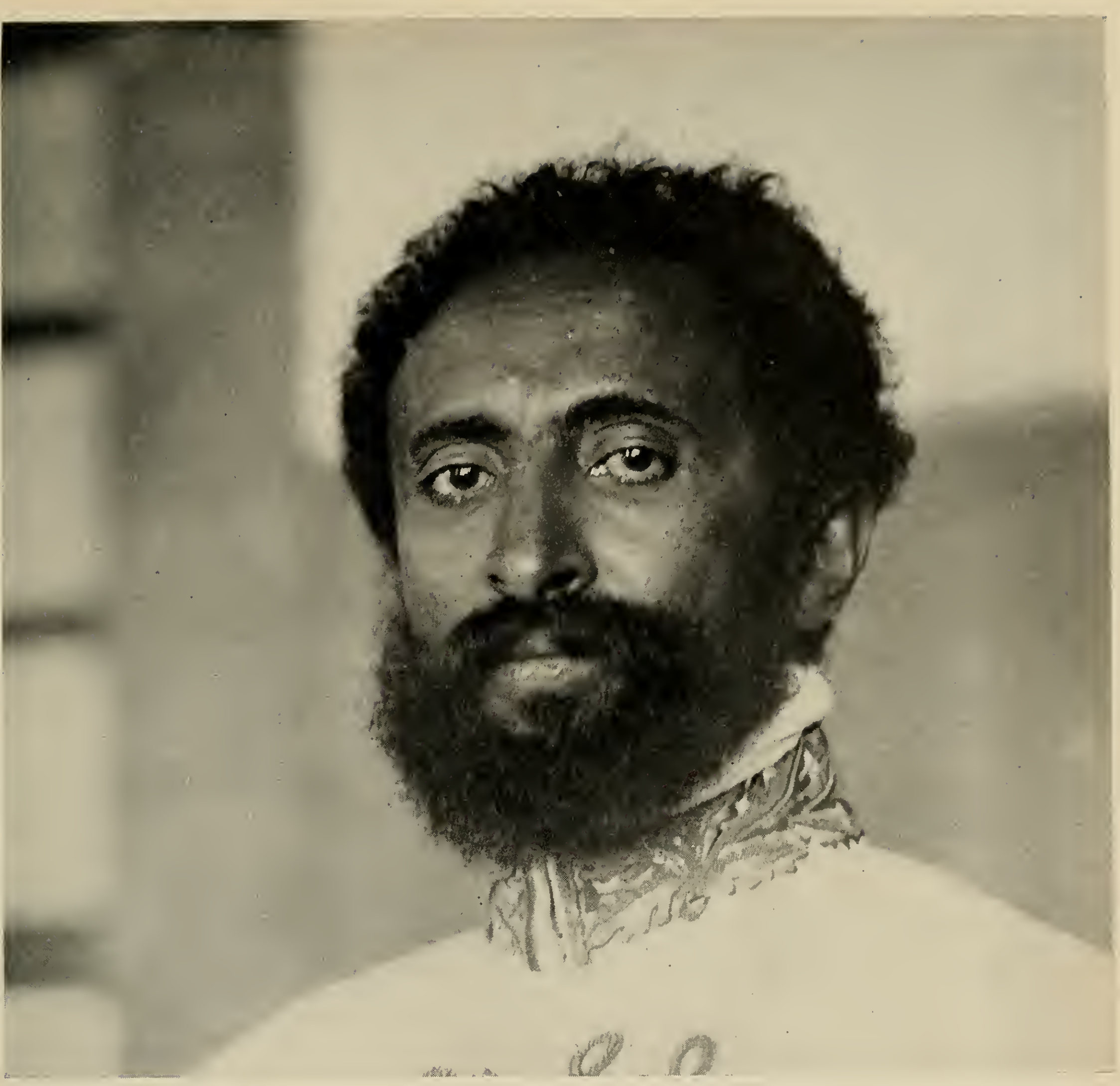
For centuries what is now Ethiopia was little more than a collection of jealous kingdoms and warring tribes, some of which were naturally cohesive and others quite the reverse. The present boundaries and

A plateau in the Chercher Mountains, situated in southern Abyssinia. There is an atmosphere of contentment in this region, for the soil is fertile, and crops are raised with a minimum of labor. Irrigated groves of coffee trees line the hills, and caravans laden with coffee are frequently seen on the ancient Harrar caravan trail. At the left is a contrasting scene in Addis Ababa, where automobiles go honking through the crowds and even traffic officers occasionally are to be seen

(Above) A chief of northern Abyssinia with his followers and two visiting Italian officers

(Left) A young chief with an embroidered tunic and silken undergarments. He is accompanied by priests who are always in evidence

(Below) Coptic priests gathered at an old church. There is much feasting, fasting, and pageantry in Abyssinia, and religion is taken very seriously



Haile Selassie, the ruler of Abyssinia. This photograph was taken when the present king was Ras Taffari, prince regent and heir to the throne. He is patriotic, enlightened, and progressive, and while he is hampered by tradition and prejudice, is nevertheless the real ruler of the country

(Right) Ras Hailu, the royal-blood chief of Gojam, with a priest and an escort marching from his compound to meet the expedition led by Doctor Osgood

centralization of power were achieved less than forty years ago by Menelik II who proclaimed himself Emperor in 1889 and thereupon started an unprecedented series of conquests and consolidations of kingdoms. He was enterprising and progressive, welcoming new ideas and looking forward to the modernization of his country. Most important were his negotiations leading to the building of the railroad from Djibouti to Addis Ababa. After his death in 1913 there followed the short reign of a weakling boy-emperor, Lij Yasu, who was deposed in 1916. Zauditu, a daughter of Menelik, then became Empress to rule jointly with Ras Taffari Makonnen, who was appointed Prince Regent and Heir Apparent. It is a tribute to the power and wisdom of Ras Taffari that he was able to continue with a difficult dual régime, promoting modern ideas against considerable internal opposition until he was free, in 1930, to proclaim himself Emperor in his own right under the name Haile Selassie.

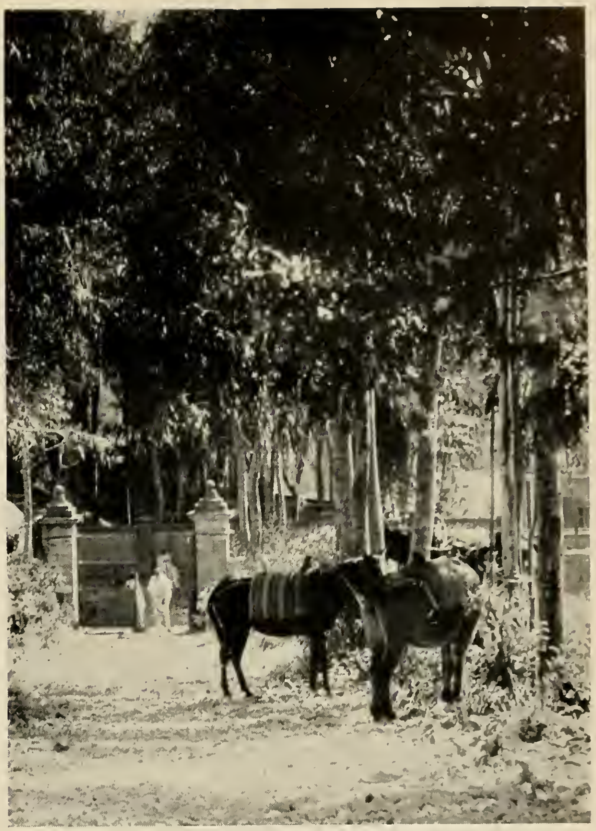
THE RULER OF THE COUNTRY

During our expedition we were variously interviewed or entertained by the Prince Regent, who quite won our admiration and respect. He is educated far beyond the majority of his people, relatively young (42 at present), progressive, and earnestly devoted to the welfare of his country. He speaks French with ease and reads widely to keep in touch with world affairs. Although possessed of great dignity and obvious firmness, his manner as we observed it was gentle and good-humored, his smile undeniably sweet and sympathetic, and his mind quick and ready. He is not large physically and there is nothing of bluster and bravado about him. He impressed us as being thoughtful, discreet, and diplomatic rather than headstrong or reckless. Nevertheless, he has a record as a fighter and, like all Ethiopians, there is no doubt he is one. It is common knowledge that he keeps in condition to take active command of his troops if necessary. That he could and would do so was testified to us by some of those who had followed him to their sorrow on long, gruelling horseback rides. His enterprise and nerve have frequently been demonstrated. For example, once when he was invited in Aden to take a short flight in the first airplane he ever saw, he immediately accepted and went up, to the amazement and consternation of his entourage.

One of the great distinctions of the Ethiopians is their adherence to a Christian religion. They are Christians of the Coptic or Monophysite branch which originated in Egypt and is supposed to have reached Ethiopia through the medium of some ship-wrecked sailors about 330 years after Christ. Practices which originated at that time are still carried out to the letter. In fact it is likely that the devout Ethiopian would regard a modern fundamentalist as a pronounced radical or, more probably, a heretic. The priesthood is very numerous and is said to comprise about one fourth of the male population. The priests do no productive labor and to that extent are parasites. There are slight signs of lessening clerical power, however, and it is even possible to find Ethiopians who are freethinkers or agnostics. Of interest in this connection was our experience with priests and minor chiefs in outlying districts who invariably brought up the subject of whether or not the earth is flat. It furnishes an interesting bit of evidence as to the stage of thought in which the country finds itself and the difficulties with which its progressive and well-informed rulers have to contend. No wonder the country has been described as having "one foot in the Middle Ages and the other in the League of Nations." In addition to the Coptic Christians, there are hosts of Mohammedans, these having been greatly augmented when the southern provinces were brought under the domination of Menelik. Pagans in the farther provinces also are not a few. Religious differences, therefore, are among the country's present and future problems.

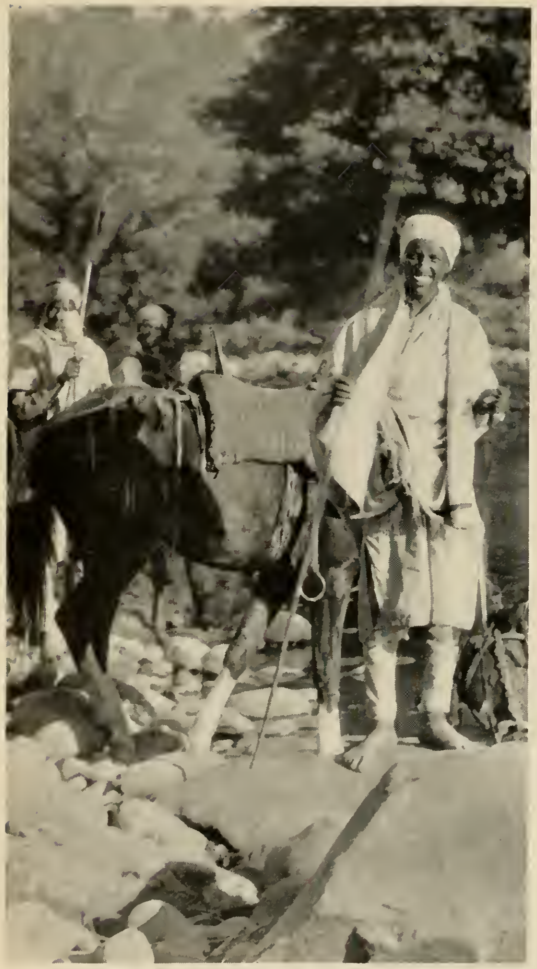
The Ethiopian terrain is a natural stronghold, the largest mountain area on the continent of Africa and the principal fountain head of the great Nile River. Although called a plateau, it is by no means uniform in character. Its grass-grown valleys range in size from mere pockets in the hills to great plains like those of Shoa,

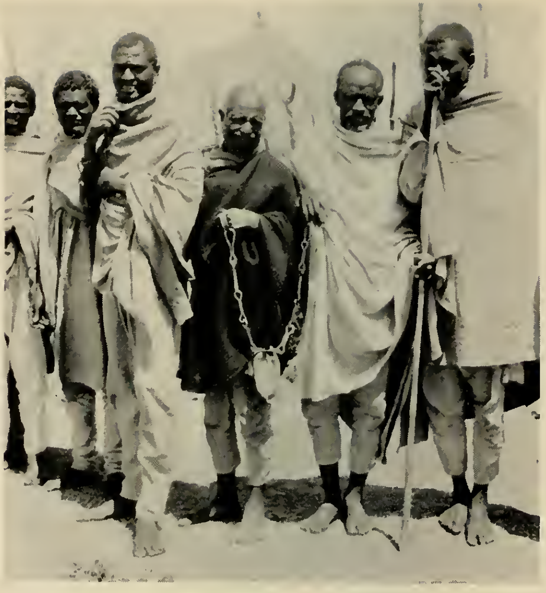
(*Above*) *The Gallas are strictly a pastoral people, who are occupied principally with their herds of cattle, sheep, and goats*



(*Right*) *The attractive courtyard of the hotel in Addis Ababa at which Doctor Osgood and the other members of his expedition stayed*

(*Below*) *Such markets as this one of Budessa are the meeting places of the natives for miles around*



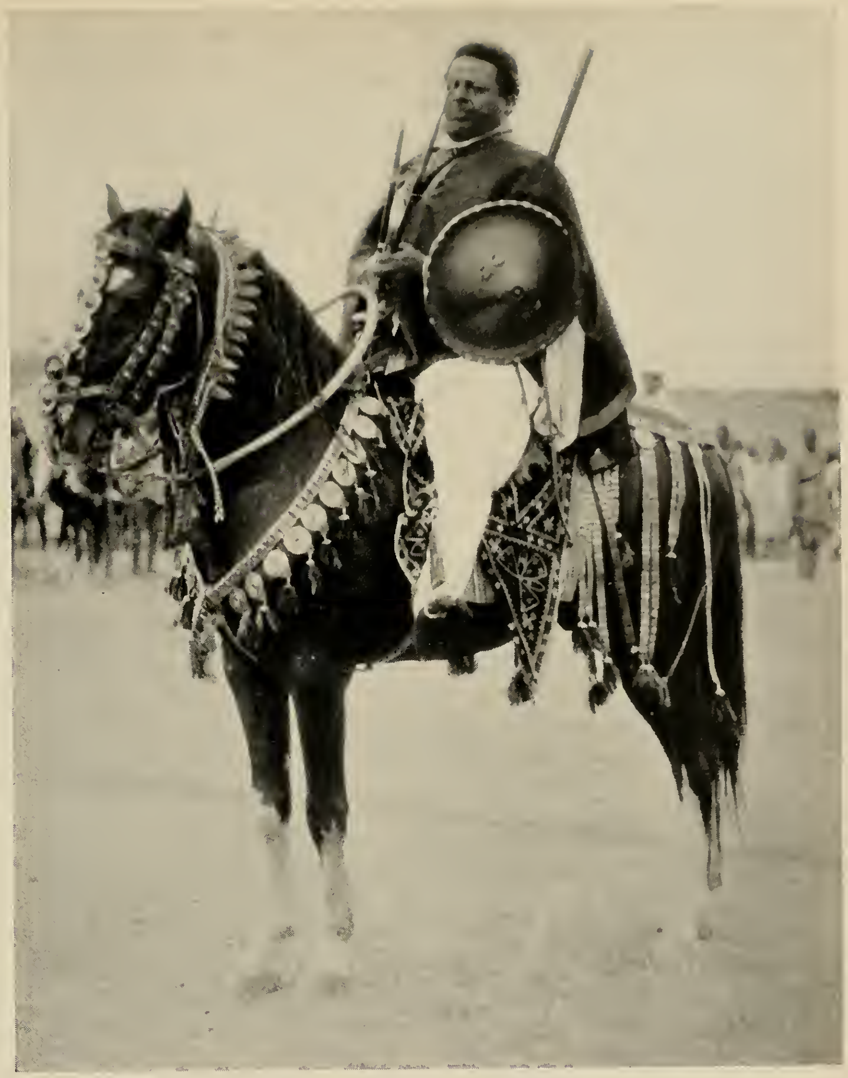


(Above) A strange old custom in Abyssinia results in chaining a debtor to his creditor

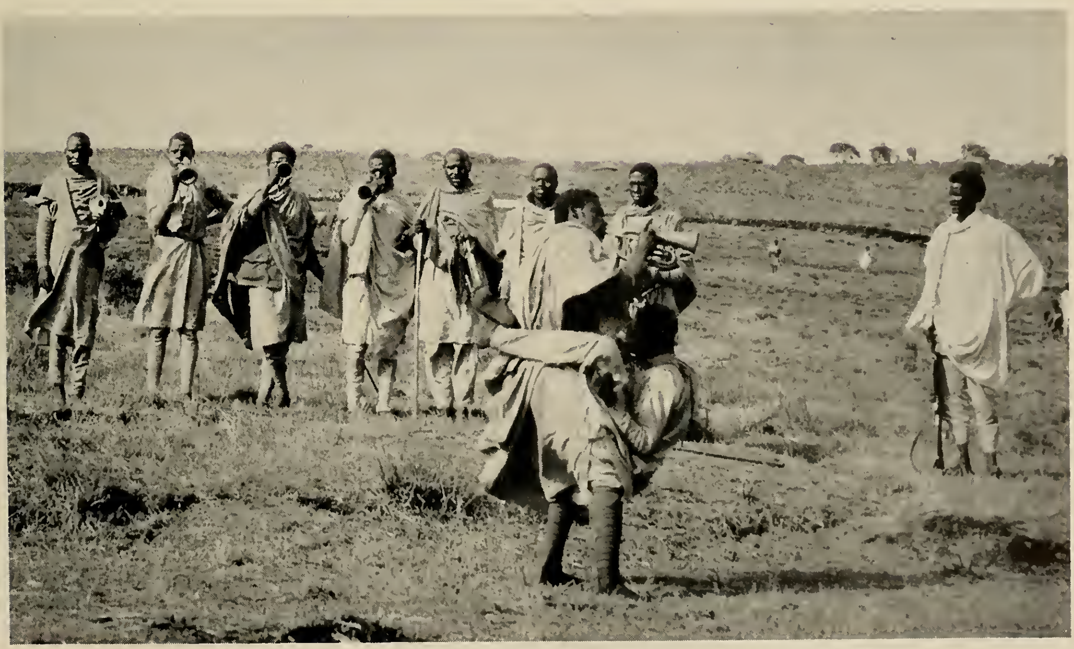
(Left) A good-natured bandit. Bodies of such men seem to prey principally upon each other, and a well-equipped expedition has little to fear from them

(Below) A horseman of relatively small means and position is nevertheless likely to be as proud as the governor of a province. They always ride with the big toe in the stirrup

Dejasmatch Ayalu is the ruler of a great part of the Simien Mountain country and the territory lying westward to the Sudan. As with all Abyssinian chiefs his power is absolute in his own territory. He makes reports and pays dues to the ruler at Addis Ababa, but the central government is remote and outlying rulers are little hindered



Music and dancing by a band of slaves. The man at the right is of the usual Ethiopian type. The musicians are pure Negroes, and, though slaves, are quite as contented as the others



where the armies of the world could maneuver. The valleys are mostly about 8000 feet in elevation and are variously bordered by rolling hills, by well-defined ranges, or by isolated mountain masses ascending to ten, twelve, and fourteen thousand feet. Here and there they are cut by deep, precipitous gorges, many of which are concealed from view until one is at the very brink of their yawning chasms. Small streams of pure water are frequent in the mountains and there are large, beautiful lakes in some of the valleys. At lower elevations, however, and especially in the south and east, there are large waterless districts to be crossed before reaching the plateau.

THE CLIMATE

The climate of Ethiopia is that delightful one always found at high altitudes near the Equator. From October to May there is practically no rain and conditions for travel and bivouac are ideal. Insect pests are so few as to be negligible and, since the dreaded tsetse fly is quite unknown, mules and horses can be used, so one travels much as he would in the western United States or Mexico. In fact, if one seeks a western analogue of Ethiopia, he finds it fairly well exemplified by Mexico. If Mexico had but one coast and if it were backed up on one side by the wilderness swamps of a great tropical river system, it would have considerable resemblance to Ethiopia.

In the wet months, June, July and August, travel in the highlands is next to impossible and any military campaign which does not take this into account is likely to find itself bogged down. At any season, the passage of the larger rivers (and the Nile is not the only one) is likely to be hazardous and only possible at particular spots. Moreover, some of the mountains are among the most dissected and precipitous in the world. This was the considered opinion of Mr. Cutting, of our party, who was fresh from ibex hunting in the Himalayas, and myself, with a varied experience in the Andes. The conditions for guerilla warfare, therefore, are excellent, at least in many large districts.

Except in and about the capital and in a few other places, there are no roads and no wheeled vehicles of any kind. Extension of roads from Addis Ababa has begun, however, and light motor cars have been taken considerable distances in an experimental way.

The possession of horses, of course, is a mark of comparative affluence and the common multitude goes on foot. Barefooted and carefree, they think nothing of trotting or walking for incredible distances. Under necessity, any of them under forty years of age would run for twenty-four hours at a stretch and think nothing of it. "Carrying the message to Garcia," therefore, is one of the easiest things they do. At this sort of thing I would match them against any people in the world. One of our caravan men was exceptionally fleet, and as we watched him, we could not avoid expressing the wish that he might be put in training to contest the distance championship of the world. The Ethiopian is also practised in making long, solitary journeys in concealment, since this is a common necessity, even at the present day, on account of intertribal hostilities.

The resources of Ethiopia, so far utilized, are mainly those of an agricultural and pastoral people. The food supply, although not greatly varied, has always been ample for their needs. This has been so in spite of primitive methods and in spite of the large part of the population that does not work in the fields. Excluding the priests and the vassals who act as guards and hangers-on throughout the feudal society, it is evident that scarcely half the able-bodied males have any productive occupation.

STOCK RAISING

In addition to the direct products of the soil, the country has a great wealth of livestock, cattle, sheep, goats, and poultry. The one common domestic animal they do not have is the pig, for the Copts will not eat pork and the Mohammedans will not even touch it. No one knows the number of their cattle, but it must run into millions. They are of the humped variety and probably came in from India at a very early date. The conditions for stock raising are almost ideal and it seems scarcely open to doubt that Ethiopia might take an important place among the meat-producing countries of the world. Our expedition, which at times was divided into two sections, was able to cover nearly 2000 miles of trail and to make nearly 200 separate and distinct camps. We never had less than thirty mules and horses and, occasionally, there were as many as seventy-five. Yet natural forage and water for them was only rarely insufficient in a few districts not on the main plateau. By and large, forage was never a serious problem.

The mineral resources of Ethiopia are not very well proved at present and it is not unlikely that they have been exaggerated. Volcanic formations prevail throughout most of the better known parts of the country and reports of minerals come mainly from western provinces that are relatively inaccessible and rather loosely governed. Placer gold in limited quantities has been brought out for centuries and, no doubt, a gold-bearing area exists. Nevertheless, no development has taken place.

THE FORM OF GOVERNMENT

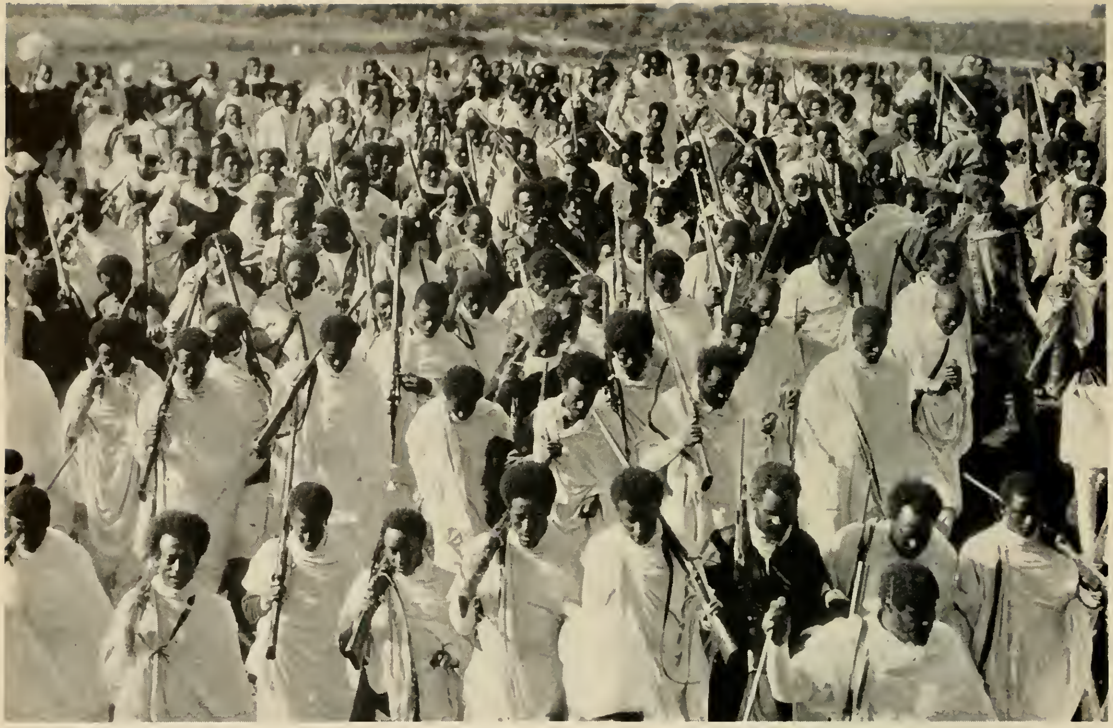
Ethiopia is still an old-fashioned, absolute monarchy. At least theoretically, the hereditary ruler is all powerful with all landed rights and full dominion over each and every one of his subjects. Every man is subject to his call to arms and, through a hierarchy of provincial governors, overlords, and petty chiefs, every man is subject to taxation and to other forms of service. It might be supposed that this would produce a race of subservient people, but such is not the case. It seems rather to promote loyalty, a fighting spirit, and a passionate desire to protect one's own. This is not to say that jealousies and intrigues, bitterness and suffering do not exist; but if one is brought up from childhood to follow a leader, to defend him, to fight for him and risk one's life for him, then the idea of fighting for a cause is likely to become fixed. Personal bravery is the greatest of virtues and the coward is everywhere laughed down.

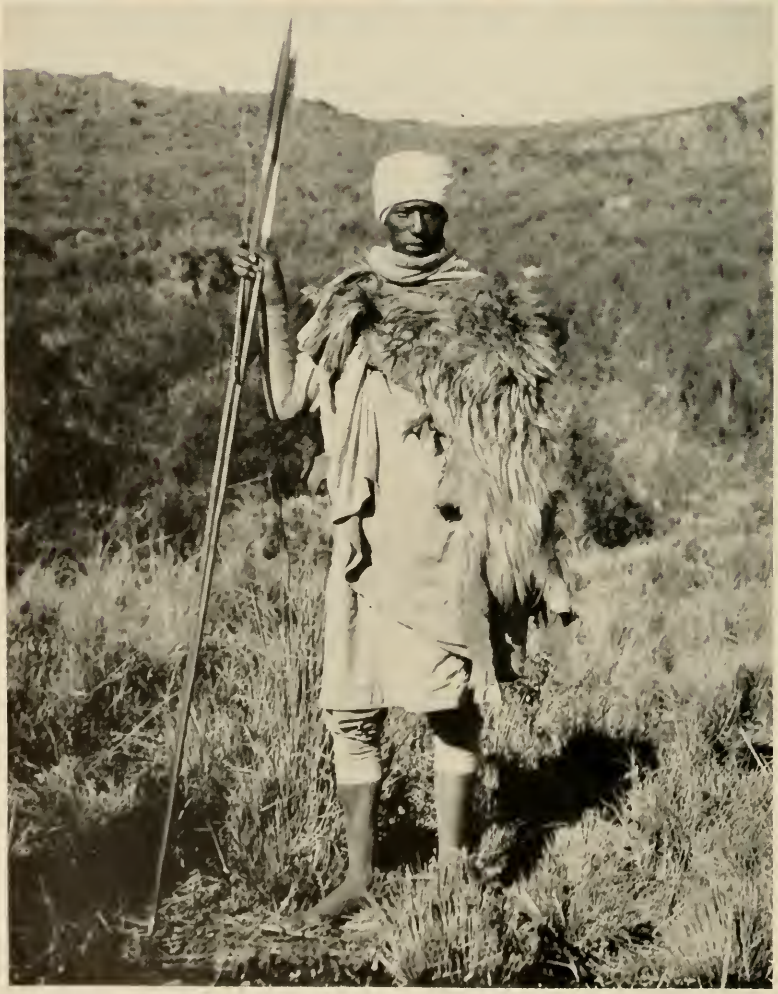
Actually, the power of the sovereign is considerably modified by the provincial chiefs, some of whom have very large followings. Councils of these chiefs or governors are being resorted to more and more, and the seeds are being sown for at least a slight semblance of representative government. There are some twenty provinces of varying importance. Although appointed by the Emperor and under tribute to him, the governors receive no salary and must perforce exact their tribute and personal fortunes from their subjects. This, of course, can lead to vicious practices, but the actual necessities of life are so easily obtained that individual suffering is minimized. In Addis Ababa one sees a certain number of ill-nourished and obviously unhappy people, and it is well known that certain diseases may claim a good many, but taking the country as a whole, the people give the general impression of being well-fed, strong, and vigorous.

CHARACTERISTICS OF THE NATIVES

The men of our caravan were as miscellaneous a lot as one would find anywhere, but all were marked by a certain independence and by a disposition to demand what they regarded as their rights and thereafter to set great store by the sanctity of their contracts. Pride and suspicion were usually apparent, but a sense of fairness was highly developed. Their ideas of right and justice are based on good old Christian precepts and the simple, direct way in which they would fall back on them often took us by surprise. Having, myself, been born in New England, I was able to meet them on their own ground, at least to some extent, and the result was usually satisfactory. After eliminating a few bad characters, we had no difficulty in managing them.

Among the best of the caravan men were quite a number whose fine qualities constantly excited our admiration. They were fine physical specimens with tireless energy, industry, intelligence, and faithfulness which could scarcely be excelled anywhere — men one would choose for service among any race of people in the world. Above all, they were never physical cowards. This was proved repeatedly in encounters with dangerous animals, in hazardous undertakings against natural obstacles of mountain or river, and in meeting real or fancied





A peace-time army merely following a chief. Though many men have guns, few have any ammunition, and some may have to go from one year's end to the next without firing their weapons

A galla warrior. The Arrusi Gallas are a hardy set, and although they lead a pastoral life, they take great delight in hunting. This man proudly assured Doctor Osgood's expedition that he had killed the "anbassa" (lion) from which his hairy cape was taken. The skin, however, was that of a goat

A Dejasmatch, or general, is entitled to wear a lion skin headdress and cloak. Such men often possess great influence in the lives of many people

(Below) An untrained caravan boy at his favorite sport — pretending to be a soldier

(Below) Though Abyssinia has many hundreds of thousands of men who could take the field as soldiers, few of them are trained. These soldiers in khaki uniforms have, however, had some training, and are shown here drilling for a local chief in a northern province. Such bodies of troops are not numerous

hostilities from local inhabitants along our way. Furthermore, their loyalty to us and their willingness to risk their lives in our defense were never in question.

These are the sort of men that would make up an Ethiopian army. They have little initiative and are burdened with custom and superstition, but under direction they work willingly and efficiently. In their feudal system, as guardians and armed followers of their lords, they do no work and spend much of their time in complete indolence, lying about courtyards like so many hunting dogs. If a fight is in prospect, however, they show amazing energy. The possession of arms is pretty general throughout the country, but effective weapons are seldom available except through the provincial chiefs and the central power. The Ethiopian with a gun is usually found to have no ammunition for it and no means of obtaining any. Often he carries it proudly for years without ever firing it. The assumption that all Ethiopians are good shots and experienced riflemen, therefore, is not justified.

MILITARY TRAINING

On the other hand, the tremendous desire for proficiency with arms and the universal tradition of fighting make it certain that these men would respond quickly to training. A well-organized army does not exist. The Emperor has a small body of real soldiers well trained by experienced European officers and a few of the more important provincial chiefs have handfuls of men who have been given special discipline. Aside from these, the army would be composed of the legions of retainers who are always ready to respond to the call of their masters. They would come in large bodies, moving with no apparent order or precision, but they would not be mobs. They are accustomed to moving en masse, to carrying their subsistence, and to making and breaking large encampments. Somehow each individual would do approximately what he ought and serious confusion would be avoided. If provided with proper arms and perhaps officered by adventure-seeking drifters from the late World War, it is difficult to believe that these men could not be built into quite an effective fighting force in a very short time. Their numbers are problematical but there is little doubt that 200,000 to 300,000 could be mustered almost at once.

In default of a modern subsistence corps, probably large numbers of women and minors would follow the army, driving herds of cattle, sheep, and goats, and the countryside would be razed. For a short campaign this might be successful, but it could not be long continued. Small marauding groups could maintain themselves indefinitely. Rifles and probably machine guns may be available to them in unsuspected numbers, but a continuing supply is another matter, for their credit resources must be very limited. Their vulnerability to airplane attack is probably overestimated, for their population is nowhere greatly concentrated and their terrain provides numerous natural places of concealment for large bodies of troops. Addis Ababa, with less than 75,000 inhabitants, is the only city of any size, and even small villages are few and widely separated. The vast majority of the people live scattered about and only congregate at intervals at market places which are deserted at other times.

It is probably not open to argument that a modern first-class power determined to do so, could subjugate Ethiopia. On the other hand, it seems equally certain that it would be a very costly undertaking and very likely a long-drawn one in which the sympathies of the world might well be with the weaker party. That the Ethiopians would resist invasion to the limit of their ability can almost be taken for granted. If there ever was a country determined to the last man to fight for its territory, it is Ethiopia. It is more than a determination and might be called a patriotic fervor. One meets it on every hand and the mere mention of possible foreign subjection is often sufficient to set off a passionate outburst of feeling that is unmistakably genuine. From childhood to old age the thought never leaves them that their country may be attacked from without. That they should do anything but fight, in this event, never even occurs to them.

José

Two months from the life of a Barro Colorado coati

By Frank M. Chapman
Curator of Birds, American Museum

Photographs by the Author

WHEN, in December, 1934, I returned to my "Castle" on Barro Colorado in the Canal Zone, I was determined to have a feeding-place for birds that would defy the raids of coatis. All my previous attempts to circumvent these intelligent animals had failed. In December, 1931, toucans had just begun to feed from a tray hoisted by a pulley to the limbs of a cecropia when the coatis discovered it and the toucans knew it no more. Other devices were equally futile. Unfortunately all my prospective bird guests, toucans, tanagers, honey creepers, etc., were fruit-eaters, and I had nothing but bananas and papayas to offer them. Both of these fruits are favorites of the coati; of the former, indeed, he is inordinately fond and its far-reaching fragrance appeals to his marvelous sense of smell with all the force of a dinner bell to a hungry boy.

Some years ago, to prevent ripe bananas from drawing insects into the house, I placed them in a well-covered mail box nailed to the clapboards just outside my door. A few hours later, when I returned, the box was down and the bananas had disappeared. After the box had been renailed to its place, a coati was seen sitting on its lid. This opened upward and the coati was therefore obliged to tear it from its fastenings before he could secure what he evidently was certain it contained. In short, coatis are highly intelligent animals with a wide range of activities. To see the dirt fly before their long, curved nails and muscular legs, as they unearth some luckless grub, is to be convinced that they are preëminently terrestrial. To watch them select and pluck ripe almendro nuts from the tip of a branch 150 feet in the air, you are equally certain that they are in the highest degree arboreal. But the promptness with which they seek the ground, when they realize that they have been seen above, leaves no doubt that it is their real home. When, therefore, I decided to match my wits against those of the coatis, I felt from various experiences that the odds were in their favor. On the other hand, I believed that there must be some place accessible to wings that was beyond the reach of a quadruped weighing from fifteen to twenty pounds or more. The air, halfway between my observation balcony and the forest, seemed to offer such a place. From my balcony post Arturo and I, therefore, ran two parallel wires, the size of a pencil-lead, to the nearest forest tree, distant twenty-eight feet, and from them hung a shallow, wire-bottomed tray. A simple arrangement of strings with a pulley attached to the tree enabled me to draw the tray to and fro. Placing a banana and slice of papaya in it, we contemplated our work with satisfaction, bade birds partake and coatis observe.

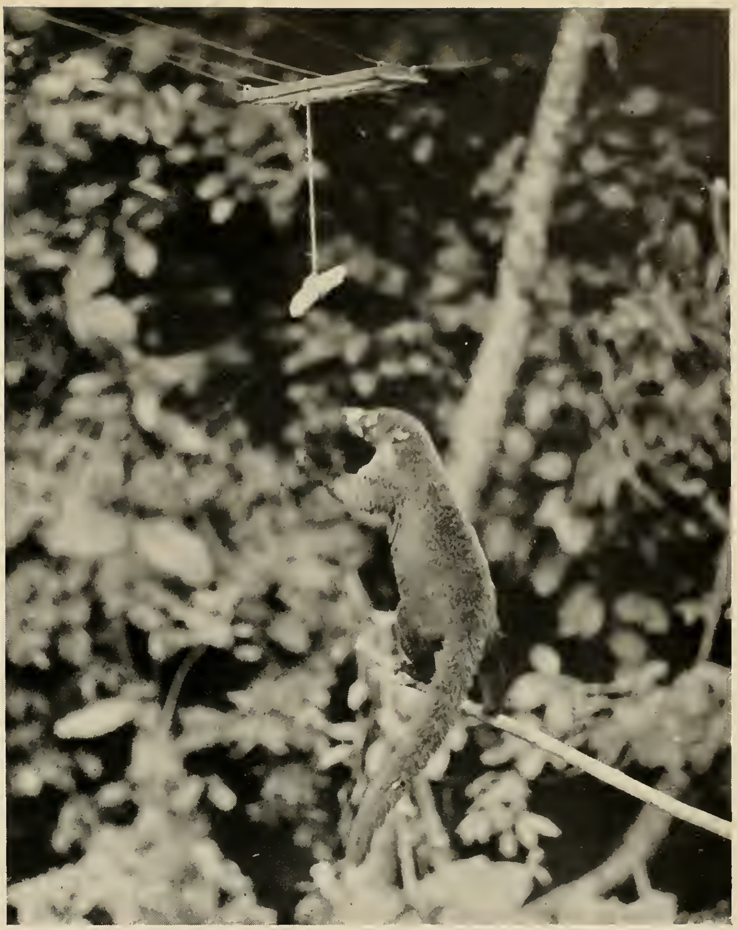
JOSÉ APPEARS

The birds, it must be confessed, were long deaf to our invitation; but at least one coati accepted it promptly. All coatis are endowed with so strong a personality that involuntarily one thinks of them not as species but as individuals. Then, if a certain animal is seen often enough, it soon acquires a name, but why this particular coati was called "José," I am unable to say, although I christened him. The name seemed to fit, and, in time, he appeared to accept it.

Apparently we had placed our feeding-tray above a route along which, in his regular rounds, José passed daily. It was his nose that first informed him there was a banana in his territory. To him its odor was doubtless as impressive as a tangible substance. He stopped, twitched and wrinkled his sensitive nostrils, and with his long,

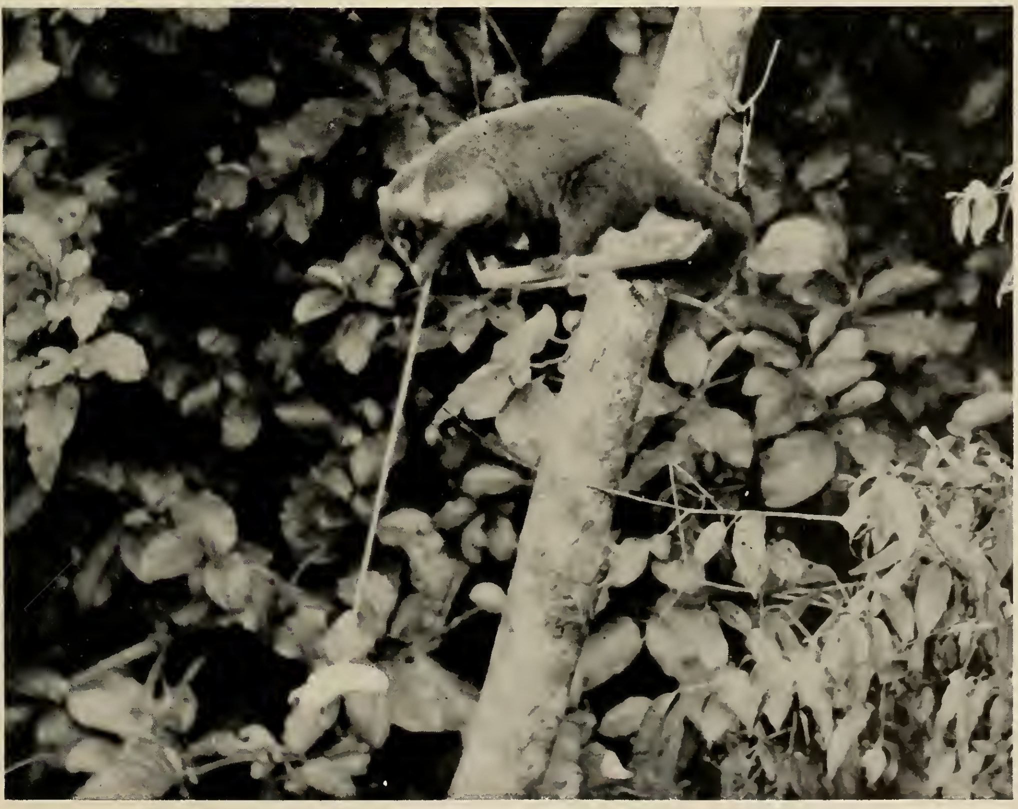
José climbs the balcony to take a banana from Doctor Chapman's hand, but he has yet to learn where the banana ends and the human fingers begin. Doctor Chapman's right foot is pressing the camera bulb

José hauls the banana upward to the tray



A supreme demonstration of balancing. Failing to reach the banana from the pole, José secures it by descending to the tray

José tackles the problem of securing a banana suspended from the tray at the end of a three-foot string



slender snout "tried the air" in circular sweeps or vertical tosses of the head. A banana might be in full view but it was his nose rather than his eyes on which he depended for information. (Later this was proved conclusively.) He went a little to the right, then to the left, climbed a stump, ran out on a reclining tree-trunk, stopping frequently to test the air, until by a series of nasal triangulations he appeared to have located the source of the smell that so strongly attracted him. Then, if possible, he went directly to it.

FOLLOWING HIS NOSE

That he could reach my tray, suspended in mid-air, I did not for a moment believe; but the situation did not seem to worry José. Having made his observations and decided on a course of action, he easily and confidently shinnied up the tree to which the wires were attached until he reached their level; then he paused. The next stage toward that increasingly alluring scent was different from anything he had ever seen before; but that did not prevent him from investigating it. Nose swaying and tossing, he pushed his forefeet carefully out on one of the wires and, balancing himself with his tail on the other wire, he covered about half the distance to the tray and the banana, when he suddenly lost his nerve and, almost falling, scrambled back to the tree.

At once he began a second trial. This time he reached the tray, grabbed the banana, and started to return with it so quickly that he lost his balance, but clung to the wire upside down and regained the tree, hand over hand. But he did not lose his head or sight of his objective. Sliding down the tree backward, he went straight to the banana, which had fallen from the tray, and devoured it on the spot. It was certainly small enough reward for the effort expended.

José soon became an astonishingly skillful wire-walker. The distance of the tray from the tree was gradually increased until it was halfway to my balcony. But if the trays held a banana, José started on his seemingly impossible journey without hesitation. One might have expected a small monkey to be at home here, but that a heavy, plantigrade animal could so quickly learn to progress on a wire so small that it looked as if it would break beneath his weight was amazing. It was, however, an obviously difficult undertaking calling for courage and skill. His body quivered rigidly with the intense muscular effort required to maintain his balance.

Only once in his many journeys to the tray did he fall. Then it turned over with him, and he seemed to dive nose first the eighteen or twenty feet to the ground. But the banana accompanied him and, on landing, without a moment's loss of time, he continued his meal.

Although José had now learned to associate the bird-tray with bananas, he continued for some days to be guided by his nose. Each time, before mounting, he assured himself by scent that there was something there worth the effort. It was not until later, and then rarely, that he climbed to the tray when it was without a banana.

JOSÉ'S ADAPTABILITY

Four days after the initial venture on December 13, I varied the proceedings by suspending a banana from the tray at the end of a three-foot string; but this procedure occasioned José no difficulty whatever. He merely continued to follow his nose. Looking over the side of the tray his eyes confirmed what his nose had already told him. The fact that the object of his desires was beyond his reach was readily remedied. With a skill gained perhaps through long experience in pulling almendro nuts on terminal branches, he hauled the banana up hand over hand, with occasional assistance from his teeth, and devoured it in the tray at ease. In fact, he became so at home in the tray that, his banana finished, he often remained there to yawn, scratch, and rest.

Further to test José's adaptability I now hung a banana from the end of a stick projecting from the hillside below my balcony at an angle of about 45 degrees. The first question to answer here was the location of the fruit. As before, this was done through the sense of smell. Then the best method of approach was considered. Seen from below it seemed to be near the tray which at the moment chanced to be over it, and it required a journey to that swinging platform to convince José that he was on the wrong track. Eventually he discovered that by going up the hill, apparently away from the banana, he could reach the base of the pole from the tip of which it swung. Then followed a journey of nine feet on the pole to reach the string. This trip occasioned José more difficulty than the one over the wires to the tray, and demonstrated the importance of his tail when climbing. There were two wires, and the one that supported his tail was as useful as the one that supported his body. But the single pole offered small support to the tail as a balancing organ, and José was upset several times before he reached the string and pulled up the banana. But he always held on to it, even when upside down, and, pulling and biting, accomplished his end. Then, victorious, he returned to the ground. On one of these trials the pole broke, depositing José ten feet or more down the hill. But he seemed as resilient as rubber. The banana fell with him and was at once retrieved. I regret that I cannot show José the motion picture I have of this incident.

INTELLIGENCE TESTS

In the next test of José's intelligence, a string was thrown over a single wire about ten feet from the ground. A banana, tied to the free end, hung about three feet below the wire and hence seven feet above the ground. The other end of the string was made fast to the ground directly under the banana.

This puzzle José solved almost at a glance. Approaching upright, on his hind legs, he was soon convinced that he could not reach the banana, so he clasped the grounded string in his forepaws and, sailor-like, pulled it down. When the banana refused to cross the wire he pulled harder and, as a last resort, furiously bit the string until it was severed and the banana fell at his feet.

The ground, or longer end of the string, was now moved to the end of the nine-foot pole, previously mentioned, where its relation to the banana hanging over the wire was less obvious than when it was directly below it. But it was sufficiently clear to José, and although the hauling and biting were done less easily from the unstable footing at the end of the pole, they were never shirked, and sooner or later the prize was won.

PERSISTENCE

Persistence, indeed, was José's dominant characteristic. He might rest between attempts, but in no single instance did he fail to win his reward. After a fruitless effort he would retire to a favorite resting place on a partly fallen trunk, stretch out with chin on paws, at intervals yawn widely and otherwise give evidence of the fact that he had no interest in bananas. But ever and again their tantalizing fragrance reached his nostrils, his head went up, he whiffed the air on this side and that, and finally, unable to resist, returned to another and, eventually, successful attempt.

Without a diagram it is difficult to give a clear conception of José's actions. Whether intentional or not I do not pretend to say, but he often apparently followed plans which seemed at first to lead him far from the end in view. Thus, when I hung a banana from a single wire, he seemed to realize at once that it was beyond his reach and made no attempt to climb to it. But that does not mean that he gave up the banana. Climbing up the tree to which one end of the wire was fastened, he pulled the wire so violently that the banana was shaken from it. Whether José anticipated this result or just pulled on general principles is unknown, but the moment the banana fell, he hastily descended the tree and went to it.

This maneuver was repeated with variations. In one instance the banana was hung from the tray on its trolley midway between my balcony and the forest, where it apparently could be reached from the end of the pole already mentioned. The pole was first tried, and although José gave a supreme demonstration of his balancing powers by rising to an upright position at its end, he lacked the nerve to make the needed spring for the fruit. Whereupon he returned to the ground, went fifteen feet to the base of the "tray tree," climbed

1.

The suspended banana proved to be beyond José's reach

2.

So he climbs outward on the pole from which it is suspended

4.

Then devours it at his leisure

3.

Seizes the string and pulls it up

twenty feet up to the attachment of the trolley, slid fifteen feet out on the wires to the tray, pulled up the banana, and ate it where he sat. After seeing such an exhibition of intelligence, one understands why *Nasua narica panamensis* is a successful species.

A FUTILE DEFENSE

Another case in point occurred late in our relations. Finding that a tray suspended in mid-air was as accessible to coatis as it was to a pair of beautiful "Sangre del Toro" tanagers that had begun to visit it, I decided that the birds' rights must be defended. Arturo, therefore, placed on the "tray tree" below the trolley wires, a large umbrella-cone of sheet zinc. In vain the other coatis tried to surmount this guard. Around and around they climbed beneath its overshadowing roof, no opening could be found. In vain they tried to climb over it; and shortly, they abandoned further attempts. But, so far as I know, José never tried to pass this obstacle. His familiarity with the surroundings taught him a better way. Going thirty feet farther into the forest he climbed another tree to a point where its branches touched those of the tray tree, crossed to it, and slid down it to the point above the guard where the trolley was attached and, as before, slid out on the wires to the tray and the tanagers' banana.

To learn more clearly the respective parts played by José's eyes and nose in the location of food, I carved and colored a wooden banana with such unexpected success that a banana grower to whom I showed it told me the variety to which it belonged! When this was exposed alone, it attracted no attention; but when there were real bananas near it to supply the characteristic banana fragrance, its appearance was sufficiently deceptive to call for some inspection. At the most a mere touch, and more often a sniff at a distance of six to eight inches, was sufficient to reveal the fraud. Another experiment supplied more convincing proof that José's chief provider is his nose.

After he had become wholly accustomed to securing a banana tied to the end of a string hung from what was designed to be the tanagers' tray, the suspended banana was placed in a box. It was thereby concealed from his eyes but not from his nose, and the boxed banana was retrieved just as readily as though it had been fully exposed. When, however, the box was hung without a banana, the absence of the fruit was usually discovered by sniffing from the ground and no closer inspection was made. But if a banana was placed in the tray and an object about a banana's weight, in the box, the tray banana was eaten and the box hauled up to within six or eight inches and then quickly dropped. This test was made repeatedly and no one seeing it could doubt José's complete confidence in the information he received from his nose.

It was to be expected that news of José's good fortune should spread through the neighboring forest. It may have been banana borne, it may have been communicated by the coatis themselves. The fact remains that I had visits from other coatis than José.

During the greater part of the year male coatis live alone, while the female is accompanied by her five or six young, probably until, in the summer, another family appears. Several times I was visited by a female and her well-grown children; a harum-scarum lot scampering through the edge of the forest and coming out cautiously for bananas; for they had small faith in me. If José was present on such occasions he paid no attention to these strangers. Perhaps he would not have recognized them if they had been his own offspring.

Several times a second male appeared. Just what his relations were with José I do not know, for the two were never present together. José was slightly the larger and I think the older of the two and was further distinguished by a golden suffusion resulting from a dash of dilute picric acid I poured upon his back. This enabled me to identify him, not only at home but should I chance to meet him abroad.

It might be imagined that an unfailing supply of bananas would induce José to make the vicinity of my balcony his permanent abode. In truth he visited me but twice daily, in the morning and again in the afternoon. The length of his stay was not

A nasal reconnaissance

José takes a short nap

Other coatis than José come to visit

dependent on the available supply of bananas. I was often prepared to give him as many as he could dispose of, but six seemed to be his limit. This, however, was late in the morning, and who could tell what genial assortment of nuts, grasshoppers, grubs, and lizards had preceded them? His wants supplied, José was ready for a short nap in one of several favorite resting places in the fallen tree I have already mentioned, but for a real siesta he disappeared for several hours within a maze of vegetation enveloping a large tree just within the forest.

In spite of sundry falls, empty boxes, and a wooden banana, José did not lose faith in me as the ultimate source of a delectable food, while José's patience, perseverance, and ingenuity aroused in me a desire for a closer acquaintance with an animal of such unquestionable intelligence. By this time José had in a large measure lost fear of me and learned to look to my hand rather than to the tray or the end of a string for his favorite food. This advance in our relations was not made in a single step. It was some time before, with hesitation, he climbed the balcony, and snatched a banana from my hand in a manner that paid small regard to my fingers, and fled with it to the forest.

But the expected danger never materialized. Always there was another banana awaiting him. Perhaps, after all, it was not necessary to be so hurried. So, step by step, always forward, new associations were formed and the banana eaten calmly while I held it; an act, by the way, calling for a mutual exhibition of good faith.

That I reached José's stomach no one can doubt; that I passed beyond it to his heart is perhaps too much to expect of a creature whose heart, so far as man is concerned, had heretofore performed only a physiological function. Be that as it may, the time came when the call of his kind was stronger than any I could exert, and José disappeared. Doubtless he had abandoned the solitary ways that probably have won for him the name of *gato solo*, and gone to seek a mate in the forest.

Day after day passed and the fully ripe, strongly scented banana that each morning I placed on my balcony railing was uncalled for. But I do not give up hope that in his own time José will return to me — and more bananas. And what a story he will have to tell! What a contribution he may make to the study of sexual selection. I want particularly to know if his rich, golden, picric acid coat did not distinguish him among his rivals.

POSTSCRIPT

February 11, 1935. After an absence of two weeks José returned today. He was on the tanagers' tray when first I saw him, and after he had finished the banana he was eating, returned on the trolley to the tree at the edge of the forest. Thence he made no attempt to reach the ground over the zinc guard but climbed twelve feet up the tree to a swinging vine. This he descended, sailorwise, to a partly fallen trunk over which, by a devious route, he reached the earth. He was now well down the hill in the forest, but in response to my call, with some hesitation, for during his absence the world had not been kind to José, he came to the balcony and took a banana from my hand.

It was not necessary to ask José for his story. As he approached, it was told graphically and gruesomely by his wounds. No longer will the stains of picric acid be needed to identify him. He will be forever marked by his scars. His left shoulder is widely gashed, he will doubtless lose the sight of one eye, his left upper lip is torn and hanging, revealing all the teeth it formerly covered, and he bears minor injuries from the end of his nose to the tip of his tail. Surely he is a "bonnie fighter." What, I thought, is the condition of his enemies? But my sympathies are with José. Doubtless aided only by nature and his rugged strength he will recover. Nevertheless, I long for some means of winning his confidence and treating his wounds. At least I can give him an unfailing supply of bananas — and there will be no strings attached to them.

In Quest of the Giant Panda

An account describing the work of the Sage West China Expedition in the highlands of Szechwan Province, near the borders of Tibet

By Dean Sage, Jr.

DAYBREAK of September twenty-fifth found Bill Sheldon and myself climbing the precipitous slopes of the Chen Lliang Shan in search of bharal — *pan-yang* the natives call this aberrant member of the sheep family. Below us, on a tiny ledge of the mountain-side, 10,000 feet above sea level, our camp seemed to hang in an infinity of space. Above us towered the mighty peaks of the Chinese-Tibetan borderland, rearing their craggy summits 20,000 feet into heavens that glowed softly with the first rays of sunrise.

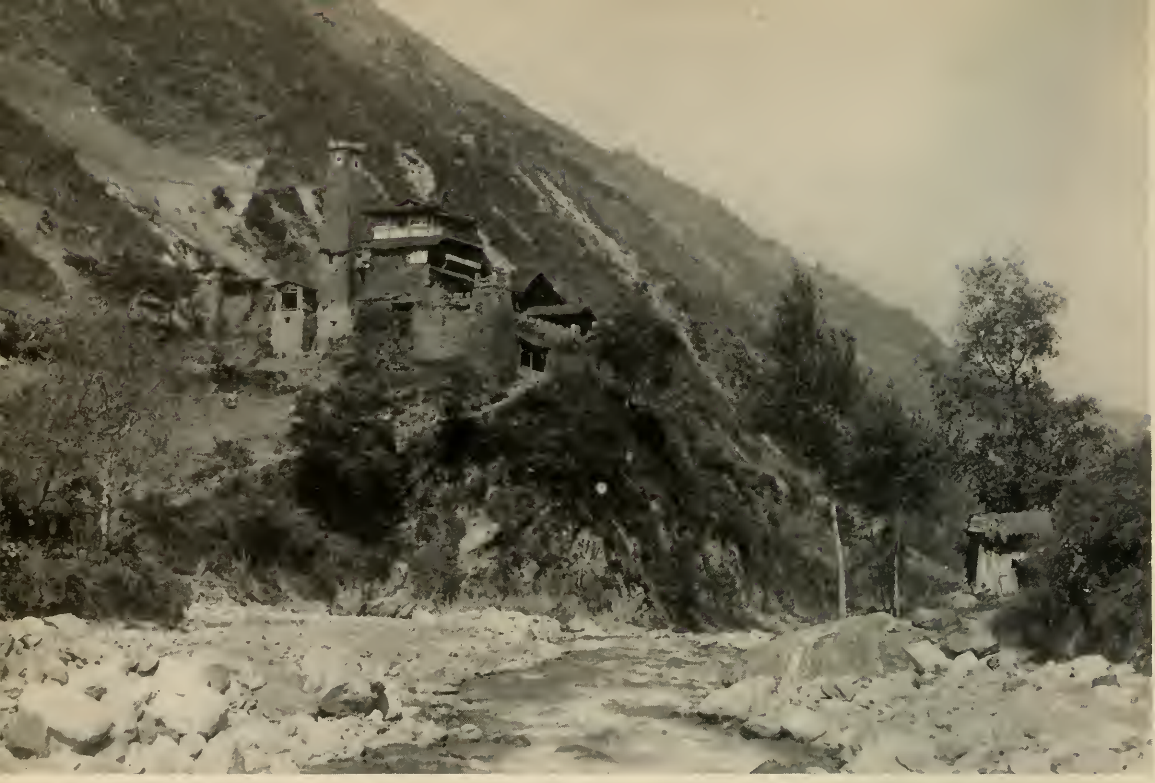
Three days of hard climbing through rain and fog had been required to reach this camp from the little hamlet of Tsao Po in the foothills, and before that, a whole week of foot travel from the city of Cheng-tu down on the plain. Cheng-tu had been our jumping-off place. One of China's famous walled cities, the capital of Szechwan Province, Cheng-tu lies on a fertile plain almost two thousand miles inland from the sea; two thousand miles of slow but interesting travel. The initial, and longest, stage is the fifteen hundred mile boat trip up the Yangtze River from Shanghai to Chung-king. Day after day, the vast panorama of the Yangtze valley unfolds itself as the little steamer chugs steadily against the broad, heavy current of the yellow waters. Endless fields of corn and rice, dotted with occasional farmhouses or small villages, stretch away to low ranges of distant hills. Ponderous junks sail placidly downstream with the current or are towed upstream against it by coolies straining along a towpath on the river bank.

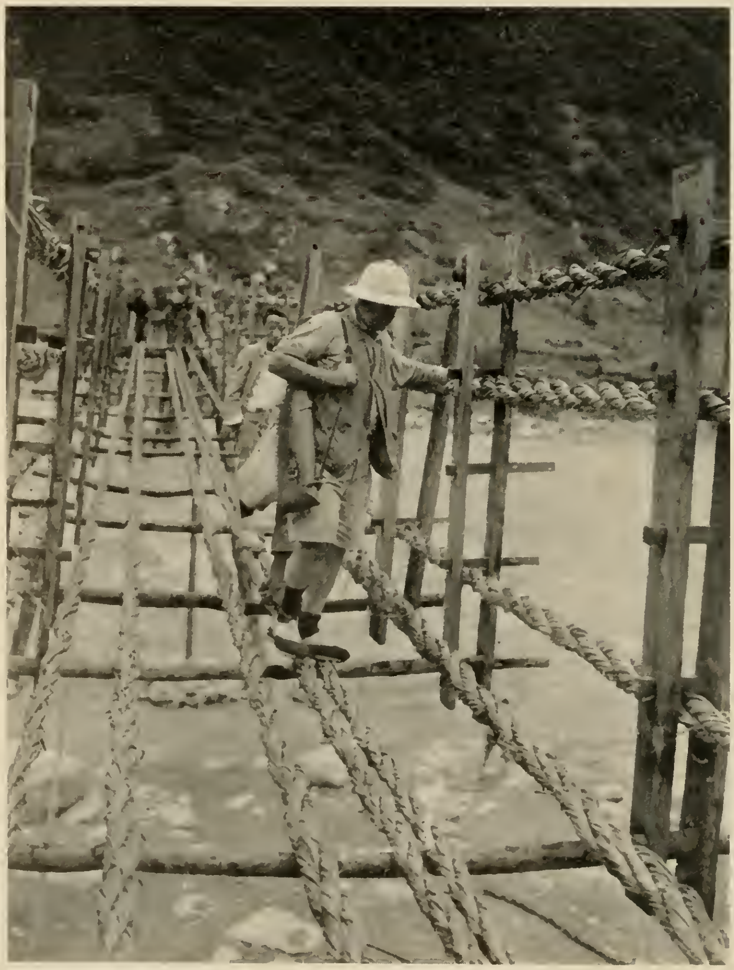
At Ichang, a thousand miles west of Shanghai, the river narrows abruptly, and for the next hundred and fifty miles boils a tortuous course through a deep, cañon-like channel, which it has cut in a rugged, mountainous country. Sparsely covered slopes, and sometimes sheer rock walls, rise abruptly on either side. The occasional, inevitable farmhouses cling precariously to these same slopes — one wonders how — surrounded by patches of corn and beans. Wherever there is a plot of earth, it is sure to be cultivated, and one is forever being surprised by some isolated patch of corn growing on top of a cliff about which a goat would think twice before climbing.

Two weeks after the date of our departure from Shanghai we reached Chung-king, a great, noisy, colorful Chinese city perched on bluffs at the junction of the Kialing River with the Yangtze. In the bedlam of sights, sounds, and smells which comprises Chung-king, we had our first initiation into the actual heart of Chinese life far removed from the big coastal ports.

Passports and permits were procured from the military officials in Chung-king, and motor transport chartered to carry ourselves and our equipment overland to our next objective, Cheng-tu. This journey we accomplished in two days' travel over a wretched bit of road, and by the afternoon of September seventh we had reached the hospitable compound of the China Inland Mission, hard by the walls of Szechwan's capital.

The long months of planning, preparing, and traveling were nearly at an end, for on a clear day we could see the snow-capped Titans of the borderland remotely beckoning from the western horizon. Our eagerness to be in the field and at work knew no bounds. Donald Carter, Bill Sheldon, my wife, and myself, whom the American Museum of Natural History had euphemistically christened "The Sage West China Expedition," felt that our goal was at hand and that we would soon be collecting birds and animals in the wild and inac-





(*Above*) *The castle of a prince of the Ch'iang tribe, at the village of Tsao Po*

(*Left*) *A bridge across the Min River. The cables are made of bamboo fibers*

(Above) The members of the Sage Expedition, with their coolies, pause for a rest on the summit of a pass in the giant panda country

(Right) The China Inland Mission, just outside the city walls of Cheng-tu

(Below) A Chinese junk in the rapids of the Upper Yangtze River

cessible region whose lure had brought us halfway round the world.

Our porters preceded us out of Cheng-tu on the morning of September tenth, an impressive line of heavily burdened coolies that became consistently less impressive and consistently more irritating as we struggled with the trials of the march across the plain, through the foothills, and then into the fastnesses of the mountains themselves. And what mountains they were! Rising rugged, in serried masses, from deep-cut, narrow valleys, they seemed fairly to hurl their jagged peaks against the sky.

THE ASCENT TO CAMP

From the outset we were hampered by the weather. Day succeeded day of fog and rain, and as the autumn passed and the weather grew colder, occasional snow flurries would come swirling out of the north, driven by winds that howled wintrily through the crags, and chilled us to the bone.

The ascent from Tsao Po to our camp in the blue sheep grasslands was fairly typical of what we encountered. I quote from my diary:

"Even when we started, the clouds were fairly low, and it was impossible to see the mountain peaks, but from the general contour of the land, we seemed to be working up to a pass across the ridge which lay in front of us. The trail led directly upwards, about as steep as it was possible for a man to climb. Bill and I pushed ahead with the hunters, while Anne and Don brought up the rear to keep the stragglers going. We had about fifty men with us, and it was natural that some of them should be slow.

"We had climbed for less than an hour, when we passed into dense, wet clouds, and from that time to this, we have not been out of them. After a long pull through a bamboo jungle we emerged on to a little, open shelf and stopped for lunch. It was about twelve-thirty. From there we climbed up a steep and very sharp hog-back ridge covered with rhododendrons and spruce. The clouds were so thick that we could see only a short distance ahead, but the ridge was so narrow that you could look off on both sides at once into a blank sea of mist. What lay below us, we could not tell. All that was apparent was that we were climbing up a mountain which seemed to have no top. Whenever we reached a level spot, we congratulated ourselves that at last we were on the summit, but always another rise would come looming dimly at us out of the fog. It was most weird, this forever climbing into the clouds with no idea where we were going or when we would get there. We had been told by the natives that there was a root picker's hut on the other side of the mountain in the grasslands. This hut was known to the Tsao Po men as the *Bei Mu Poung-tze* (literally 'white root hut'), and was our immediate destination. We knew we should find water and wood there and a good camp site. Questions put to the men, however, elicited but little helpful information, for they could not agree either how far it was to the hut or how long it would take us to get there. Two wretchedly uncomfortable nights we were forced to spend on the mountain-side, cold and wet, and with but little in the prospects to cheer us.

"The morning of the third day we came out of the rhododendrons on to grass and rock slopes. The climbing we had hitherto done was nothing to what now confronted us, for the trail led up over ledges and crags whose abruptness was fairly staggering. The altitude was about 10,000 feet, and it was very cold. Up and up we struggled, inching a laborious way over slides and ledges and around precipitous slopes, with often a sheer drop from the narrow trail into the abyss of clouds below. Occasionally great rock buttresses and pinnacles loomed shadowy out of the fog, and ever we climbed.

"Signs of game began to appear, sheep tracks, and the droppings of badger and pheasant. I carried my rifle ready on the chance of surprising something in the gray dimness through which we traveled. It was about one o'clock when we reached the summit of the pass, 11,600 feet. The ground suddenly flattened out and gave way to a series of gently rolling inclines and grassy hollows. The fresh track of a leopard

(Right) The precipitous mountains over which the Sage West China Expedition hunted for blue sheep on the Chinese-Tibetan borderland

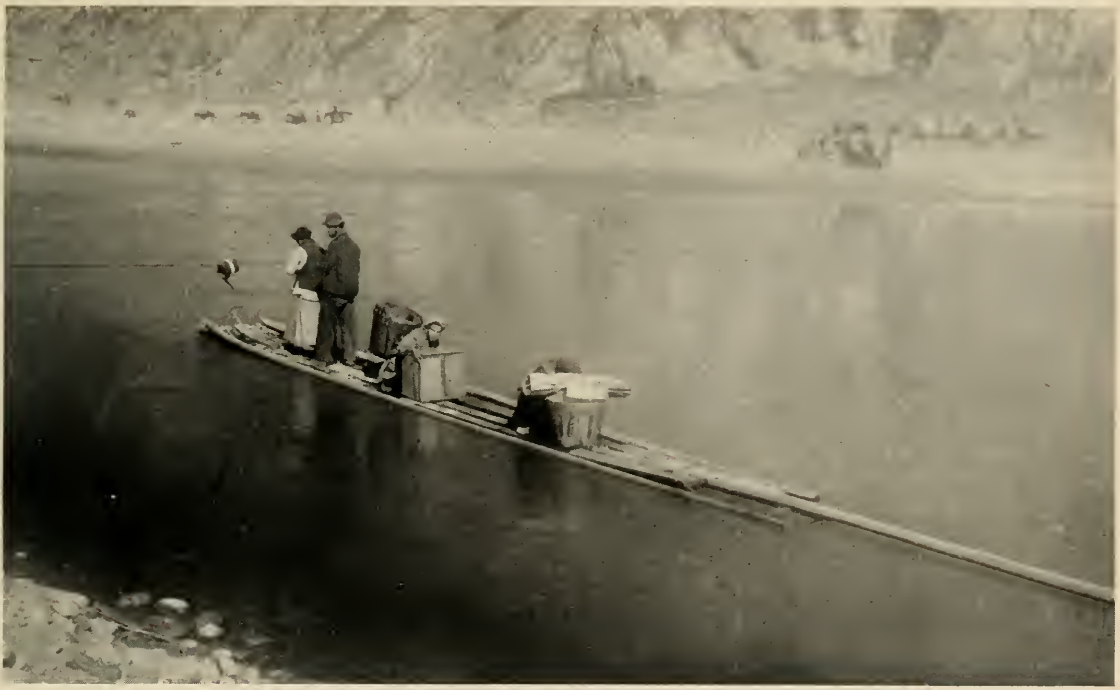
(Below) A native farm on a mountain-side in the province of Szechwan, between the walled city of Cheng-tu and the borders of Tibet

(Left) The members of the Sage West China Expedition of the American Museum meet a collector operating in the same region for the Field Museum of Chicago. From left to right: Dean Sage, Jr., Anne Tilney Sage. William Sheldon. Floyd Smith, the Field Museum collector, and T. Donald Carter

(Above) A photograph taken at an altitude of 13,000 feet in the blue sheep country, looking out over a sea of fog

(Left) A native with a bharal (wild sheep) collected by the Sage Expedition

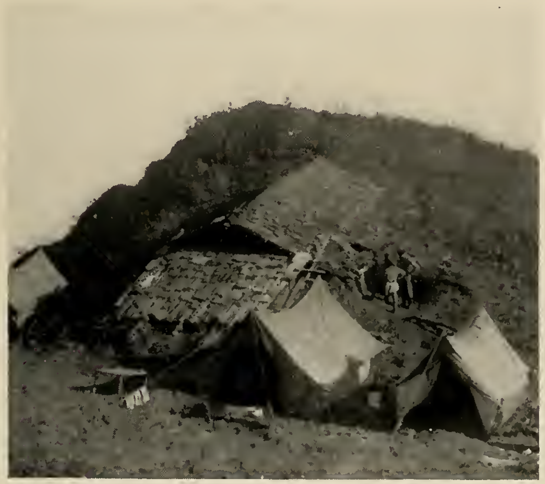
(Below) Mrs. Sage and T. Donald Carter preparing the skins of small mammals in camp



(Above) William Sheldon crossing the Min River on a bamboo raft that slides along a tightly stretched cable

(Right) A waterfall in the valley through which the Sage Expedition passed on the way to Cheng Wai

(Below) Camp in the grasslands of the Chen Uliang Shan in the blue sheep country. The low-roofed building is the "Bei Mu Poung-tze" mentioned in the article



crossed the path, and game signs of all kinds became more abundant. We surprised four impeyan pheasants that flew off with loud whistles. On the ground were patches of lovely blue gentians. It was perishingly cold.

"Soon the contours began to fall away, and presently we were descending as rapidly as we had ascended. Down through the clouds we slid and groped our way, unable to see fifty feet ahead. Suddenly, without any warning, a tiny knoll appeared in front of us, and low-lying, built into its base was our long sought *Bei Mu Poung-tze,* a flat stick and mud shack with slabs of stone for a roof. Some coolies had arrived ahead of us and built a fire, and the inside of that dirty hovel was just like Paradise."

BLUE SHEEP

The end of September and the first two weeks of October we spent on the Chen Lliang Shan. We shot four blue sheep almost at the outset, and thereafter spent many long and disappointing days trying for others. Always the fog defeated us, for although we estimated that at various times we had seen in all upward of a hundred sheep, the gray pall which would occasionally lift tantalizingly to give us a glimpse of these beautiful animals, never failed to close somberly down and render stalking impossible. Often we spent hours within earshot of ledges where the tinkle of dislodged rocks told us that sheep were feeding or resting. And ever we prayed in vain for a break in the clouds.

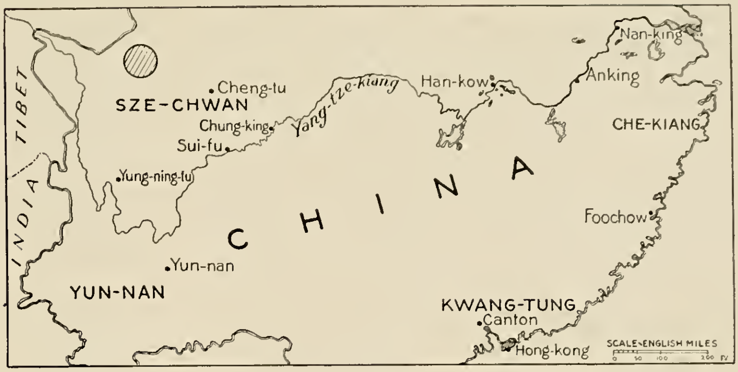
But our fortune did not depend entirely on sheep by any means, for we had run out trap lines, and our collection of small mammals was growing steadily. Birds we also began to get, mainly pheasants caught by the natives in snares and brought in to us.

On October fourteenth we left the *Bei Mu Poung-tze,* satisfied that we had pretty well exhausted — in so far as time and weather would permit — the possibilities of the sheep lands. There was other and more exciting game to whet our appetites, namely the giant panda. This rare and little known animal inhabits the dense bamboo jungles. In general, he is bearlike in size and appearance, except for his color, which is white with black markings. To the best of our knowledge, only two giant pandas had ever been shot by white men. The spectacular appearance of this creature, his scarcity, and the extreme difficulty of hunting him on the rugged and treacherous bamboo-covered slopes; all these factors made him a prize for which we aspired with the keenest enthusiasm.

Making our way northwestward, farther into the recesses of the great mountain ranges, we came to the beautiful valleys of Cheng Wai and the Mao Mo Gou. Here we had our first definite reports of the presence of giant panda. In a native farmhouse at Cheng Wai there were two panda skins. The farmer told us that beishung (literally "white bear") sometimes came into the valley. How often, he could not say. Generally, it was a single animal, though occasionally, two were seen together. Both of the animals, whose skins this man possessed, had been killed in spear traps, which we found to be the usual native method of hunting them. Infrequently, the animals' propensity for tree climbing led to one's being seen in a spot where it was possible to shoot him, even with the unreliable muzzle-loading guns which are the natives' only firearms.

And so began our quest of the giant panda. Day after day we climbed the bamboo ridges of Cheng Wai and Mao Mo Gou, in the first flush of our optimism confident of success, and as time went on less confident but ever hopeful. From the very beginning we found panda signs — chewed ends of bamboo and droppings. Some were very old; others quite fresh. We learned a good deal about the animals and their habits from our own observations and from what the natives told us. We concluded they were mainly nocturnal in their movements, wandering and feeding along ridgesides from one bamboo thicket to another, and when day came, lying up to sleep in a den amongst the ledges or in a warm spot in the sun. As to breeding habits, the natives told us that pandas mated in April and bore one cub the following January. For the accuracy of this information it is, of course, impossible to vouch.

Time passed. October disappeared into



The small, cross-hatched circle marks the region visited by the Sage West China Expedition in its search for blue sheep, panda, and other specimens

November and November into December. Our collection grew steadily as shotguns and traps brought in birds and small mammals, and skins of large animals began to come in one by one — black bear, wild boar, deer, goral, serow, takin. Most of these we bought from native hunters who, as the news of our activities spread around, would bring all kinds of skins for sale. In this fashion we even acquired a panda skin, but our own efforts at hunting the elusive beasts went unrewarded. It was hard work climbing the mountains, thrashing through bamboo jungles of unbelievable density, and as winter came on us, wading through snow and creeping over ice-covered ledges. We set spear traps; we searched acres and acres of bamboo-covered slopes with our field glasses, looking for a telltale white spot. We hunted with dogs. Unreliable curs that would run anything from a deer to a pheasant, they were a sore trial to patience.

And then one unforgettable day in December the gods relented, and the valley of Cheng Wai gave up its most coveted trophy.

Saturday, Dec. 8th, 1934

"We left Cheng Wai at 8:30 this morning — Bill and I — with quite a procession; Wong, Kan and his dog, and two other natives with their dogs. We had decided to have one last, good, long panda hunt with all the dogs we could muster. I should explain that Anne and Don could not take part in this hunt; the latter because he had gone to Tsao Po, and the former because her game knee was not up to it.

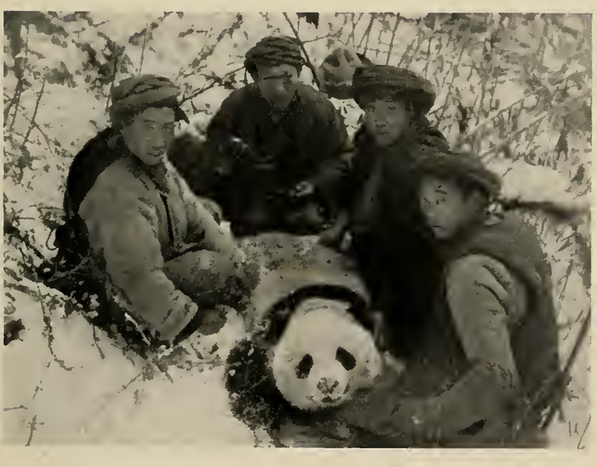
"An hour's walk brought us to some old tracks, and we turned up the ridge following Kan's route of yesterday. We climbed steadily upwards for an hour and a half, encountering the habitual cliffs and bamboos. There is no such thing as horizontal hunting in Wassu; it is all vertical! Takin sign was everywhere plentiful — more of it both new and old than we have seen anywhere else on the whole trip. We crossed one old panda track in the snow. At 11 o'clock we came to some open ledges and sat down for a bite to eat and a look with the glasses. The dogs were very restless and kept whining and testing the wind. We thought they might have detected the presence of takin, one or two of which — to judge from the tracks — had passed here yesterday.

"Ascending from the ledges, we began to swing in a general northeasterly direction along the ridge, Kan leading the way. We soon found the two- or three-day-old trail of a beishung and began to follow it. The going was very difficult, being principally through patches of bamboo and over ledges.

"We worked along the ridge for about two hours and then stopped to rest a while on a sunny slope. At this point, the pursuit seemed vain and decidedly discouraging. The track was unquestionably old; I was inclined to think three or four days, and the dogs showed not the slightest interest. They were still leashed. Curiously enough, as we were sitting there in the sun, we reviewed the shooting of both Schaffer's and the Roosevelts' beishungs and discussed the factors contributing to their success. We both agreed that almost a given set of con-

A snow-covered slope in the valley of Mao Mo Gou, where the Sage Expedition hunted giant panda

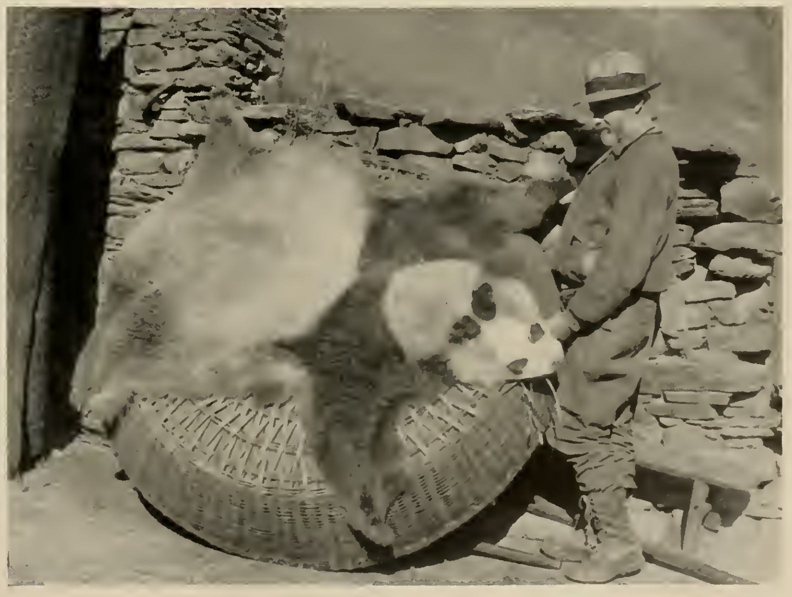
A view of the most remote mountain range reached by the Sage West China Expedition. This huge peak reaches an altitude of about 20,000 feet, and has never before been visited by white men



(Above) A typical view in the giant panda country. The picture shows a vista of the valley of Yen Hsui Gou

(Left) A group of native hunters with the giant panda brought down by Dean Sage, Jr. and William G. Sheldon

T. Donald Carter with the skin of a giant panda collected by the Sage West China Expedition



ditions was necessary to the bagging of one of these animals, and that the conditions practically never coincided with the opportunity. In view of what subsequently transpired, this conversation seemed uncannily prophetic.

"We went on for half an hour more and reached a gully where the snow was quite deep and the track looked depressingly old. I was convinced there was not a chance in a thousand. The hour was getting on, and there was not much time left to hunt. We decided as a last measure to let the dogs go and range about for a while. They started along the tracks without much enthusiasm, and we followed. I remember distinctly feeling it was a pretty hopeless chance, and I think the men felt so, too, for they kept muttering '*Beishung mutté, beishung mutté!*' I stopped to examine some old sign, and Bill and the other hunters got pretty well ahead of Wong and myself, so that they were out of sight. Hurrying to catch up with them, we came out of the snow and climbed a very steep little slope covered with dead leaves. I recall it well, for I used the butt of my rifle as a staff to help me up, and when we topped the ledge looking into a snow-filled bamboo ravine on the other side, I was breathing hard. There was a big spruce tree there, and I leaned my rifle up against it and took off my gloves. I was quite discouraged with the progress of the hunt and was turning over in my mind other possibilities as I stood there. I saw Bill moving about fifty yards above me and called out to him, 'Oh! Bill, what do you see?' He replied, 'Nothing, but the men have gone up this way; they're following the dogs.' I said, 'I think this is a fruitless procedure.' Just then came the sound of a faint and distant bark. Bill said, 'There go the dogs now,' and I called back, 'Yes, but they're way down below us.' It was true, for the sound came up the ravine on the edge of which we stood. All of a sudden I heard the unmistakable noise of breaking bamboos, and the barking became louder. Wong said, 'Beishung!'

"Even at this moment, it did not occur to me that we should ever see the animal. If indeed the dogs had started one out, the chances were he would go crashing off into the bamboos and that would be the end of it. Nevertheless, I took my gun and tried to put a cartridge in the chamber. It was all covered with snow and ice from the recent hard going, and the shell would not go in, so I threw it away, — an act which was later to become of the utmost importance — and put in another one. Above me, Bill began to climb to gain a better vantage point, but I was in an ideal spot and did not move. Up the ravine came the dogs, their barking growing steadily louder, and the bamboos crackling at a great rate. Suddenly, I heard the deep, angry growl of a large animal, and I began to get really excited. And then — as if in a dream — I saw a giant panda coming through the bamboos about sixty yards away from me. He was heading straight up the ravine with the dogs at his heels. I fired but missed. The panda made a right angle turn and came straight for the ledge I was standing on. I fired again.

He came right on, not running — walking rapidly is the only way to describe it. His head hung low and swayed from side to side. His tongue was out, and he was panting. He appeared to be looking at the ground and apparently did not see me at all. I frantically worked the bolt of my rifle and snapped the hammer on an empty chamber. In a daze, thoughts flashed through my mind: 'No more bullets; what'll I do? He's only twenty feet away, now fifteen, he's coming straight at me. Can I kill him with the butt of the rifle?' I felt a cartridge thrust into my hand. Wong had seen my predicament and picked up the one I had discarded. I jammed it in the gun and fired into the beishung's fur. He was less than ten feet from me! At the same moment Bill shot from above, and the animal, struck simultaneously by both our bullets, rolled over and over down the slope and came to stop against a tree fifty yards below.

"We had killed a giant panda."

Streamlining — Old and New

A principle long practiced by Nature, which man has begun to study seriously only since the invention of the airplane

By Harold Ward

STREAMLINING may still be news to the Man in the Street, who gazes wonderingly at every motor car with a trick body — but it is an old, old story to Nature. Regularly once a year the Automobile Show presents us with "positively the last word in streamlining"; and regularly, a twelvemonth later, we are suavely informed, by demonstrations and learned sales talks, that last year's model leaves much — in fact, almost everything — to be desired in this respect. Daniel C. Sayre, one of America's most capable aëronautical engineers, has exposed the current streamline delusion in words to which every honest technician and designer will fervently cry, "Amen!" He says:

> When they [the engineers] are told . . . that this year's automobiles, for example, have greatly reduced their air-resistance by adding false grills to their radiators, and terrible-looking excrescences to their lower rear ends, and by rounding off a few corners — they laugh long and ribaldly. *Making a 5 per cent change in last year's car and labelling the result streamlined, they will tell you, is like chromium-plating the knobs on your grandmother's brass bed and hailing it Modernist* [Emphasis in original].

If one wanted to combine poetry with a very sober truth, one could add that the very tears — of hilarity or grief — with which the aërodynamic expert views the latest developments in streamlining (at least in the bulk of commercial products) themselves exhibit Nature's way of accomplishing this result. For the "teardrop" illustrates, in transient miniature, all the essential structural features of an object designed to move through a homogeneous medium (water or air) with the minimum of resistance. Although it has not yet been established with finality that raindrops falling through the air for great distances assume the mathematically correct ellipsoidal form, it is quite certain that they do *not* fall as misshapen oblongs, with their narrow ends in front and bulbous swellings at the rear.

This is certain because of the fundamental laws of dynamics — which is defined as "the Science of Motion as produced by Force." The two laws, or principles, which are most relevant to the whole field of streamlining — whether aëro- or hydrodynamics, or whether the "engineer" be Nature or Man — are as follows: (1) The resistance exerted upon a body by the medium through which it is moving is proportional to the square of the velocity, provided this be of ordinary magnitude; and, (2) The resistance of the medium depends upon the shape and size of the body, being determined *not only by the front surface but also by the rear surface.*

Read again, and carefully, these principles — especially the italicized words of No. 2. For the crux of the matter is in them. The resistance, or "drag" offered by a homogeneous medium is determined by the *velocity* with which an object is moving through it: note that I do *not* say "speed," which is a time-rate of motion in any *one* direction, while velocity implies a change of direction. If the object is to *double* its velocity, it must be prepared to overcome *four times* as much resistance, and so on up to certain limiting values of increase. That is the first point. Now, apart from the quantity of energy applied, and the size of the body, the overcoming of resistance in the medium will depend upon the *shape* of the body, and this shape must have certain characteristics which are determined by the behavior of the medium. That is the second point, the essential problem of aërodynamics: to find for a moving body just that *shape* which will permit the greatest acceleration in velocity with the least increase in resistance and the minimum expenditure of power.

To illustrate these abstruse theoretical considerations let us take a homely ex-

X
X-ABEQ
AEROVIAS CENTRALES S.A.

Aeronautical Chamber of Commerce of America

Unquestionably, Nature's most perfect example of streamlining is not to be found among birds, though the ducks shown at the right are streamlined to a degree

The careful study of the shape of birds has played a large part in the refinement of airplane design. The gull at the left shows plainly how Nature, in one case, has efficiently solved the problem of flight

At the left is shown a transport plane capable of carrying a pilot and eight passengers. In this model the landing wheels are mounted in streamlined housings. In others the wheels are sometimes arranged so as to fold up

A sooty albatross is shown at the right. In this bird, Nature has narrowed and elongated the wings to an exceptional degree

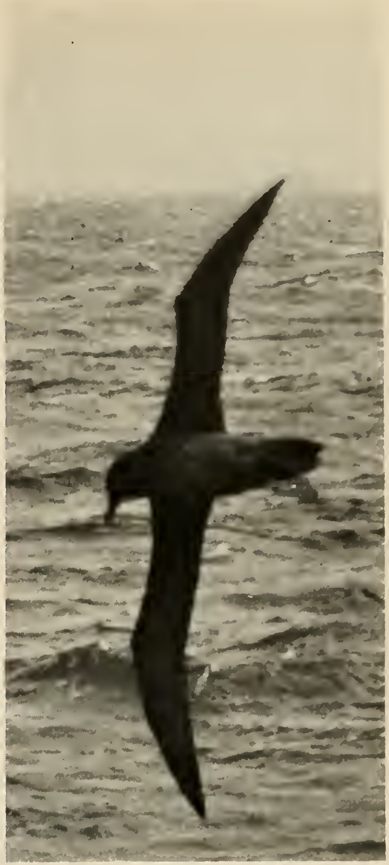


Photo by Robert Cushman Murphy

The albatross below is shown in a position that beautifully illustrates the shape of this natural airplane

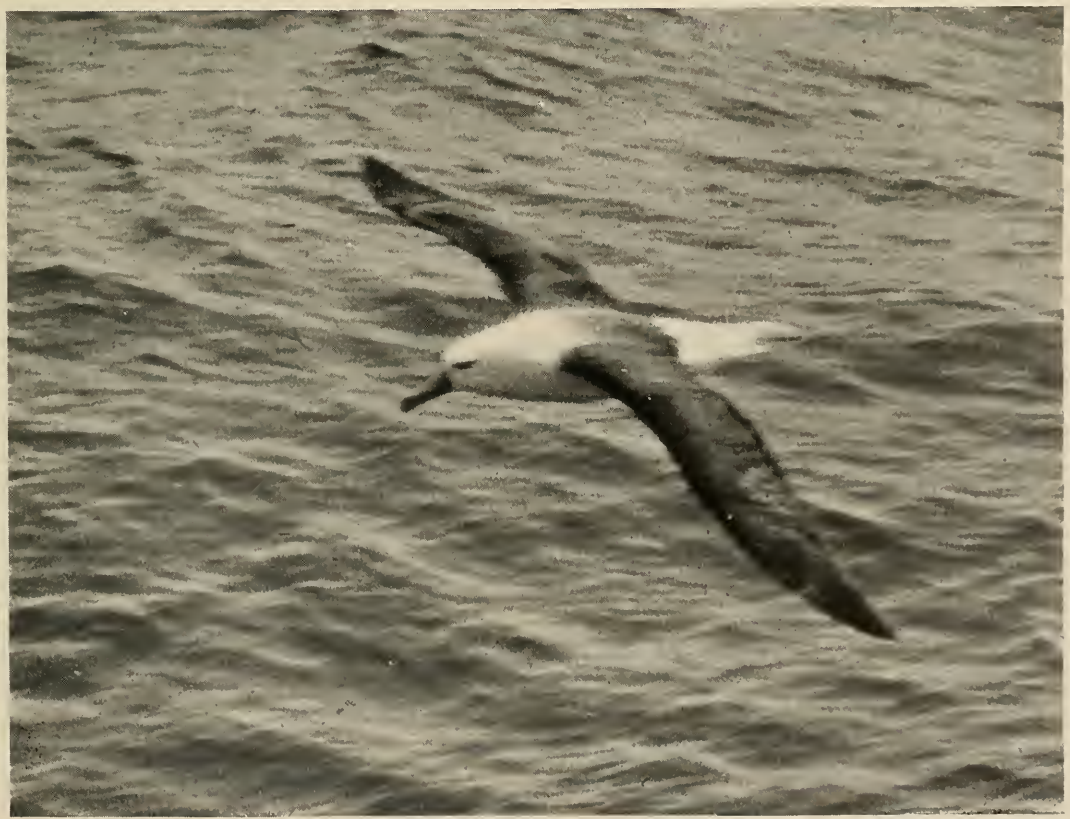


Photo by Robert Cushman Murphy

ample, which anyone may put to a test:

A flat, oblong plate — of wood or metal, with sharp edges and smooth surface — is submerged in a tub of water. Holding the face of this plate at right angles to the direction of motion, move it at a certain speed through the water. You will at once notice the "drag" which the water puts upon it, the resistance offered to its motion, and to any increase in its speed. Now, let us call this resistance at speed A 1, or unity. Next, take a squared block of the same material, its length equal to that of the plate and each of its sides equal in width to that of the plate. Submerge it in the water in such a way that one of its edges is set head-on against the direction of motion. Now move it at speed A: the resistance, despite an increase in bulk, is noticeably *less;* to be exact, it is only 0.82. Lastly, take a *cylinder* of the same length and cross section as the square block (that is, as long as the plate, and a diameter equal to its width), and move *it* through the surrounding water with its long axis at right angles to the direction of motion. *The resistance at speed A drops to 0.185.*

If you had conducted these simple experiments near the surface of the water, and were observant, you probably noticed that at each successive step there was a peculiar change in the character of the eddies — or "turbulence" as the physicist calls it — in the immediate neighborhood of the moving bodies. And each change was of a kind that permitted the *same* amount of energy to accomplish *more* work (cover a *greater* distance) in the *same* time. In blunt engineering terms, there was an increase in "efficiency" — all obtained by the simple trick of altering the shape of the body so as to minimize the chief factor in all resistance, whether of wind or water: turbulence.

THE LINE OF LEAST RESISTANCE

This trick, which man did not begin seriously either to understand or to utilize until Curtiss and Orville Wright made their historic flight at Kitty Hawk thirty-two years ago, has been one of Nature's favorites ever since fish began to swim in the oceans — even æons before that, when water dripped from stalactites "in caverns measureless to man." "Streamlining" — aëronautical engineers call it "fairing" — is the principal reason for the swift movement of fish through the water, and adds an important factor in the swifter flight of birds through the air. And, in every instance, the resulting shape takes the line of least resistance in overcoming the counter-resistance of the medium. It does so, moreover, not because of any mystical "purposiveness" or other teleological concepts which man imputes to Nature, but solely because — as a great biologist, D'Arcy Wentworth Thompson, has elaborately shown in his classic monograph, "Growth and Form" — physical laws underlie, and determine, all observable phenomena in the universe. The marvelous structure of the tuna, which includes fins that can be drawn smoothly against and partly into its body to gain speed, is no more and no less "intelligent" than the web of a spider or the hexagonal cells of a honeycomb — both of which owe their shapes to the operation of geometric principles which flow automatically from the nature of the structural problem involved.

OBEDIENCE TO PHYSICAL LAWS

On the human plane, however, it is not possible for nature to take its course. The primitive "tree-sledge" of our ancestors could be made of eternal bronze and left for eternal epochs of time to "evolve" into the sleek pursuit planes, Zeppelins, or streamlined trains of today — and nothing would happen. Nothing could happen until the technique of human transportation had caught up with human restlessness — and even then Science had to wait a weary while until men learned that the essence of all technical — as it is of social — advance is Design, and that Design means obedience to physical laws in the interests of greater operating efficiency, rather than submission to constantly changing "fashions" in the interests of novelty, sales, profits, or what have you.

Getting back to the story:

Daniel C. Sayre, whom we have already quoted, tells us that "an ideally streamlined body, something like an airship in shape, and of the same frontal area as an automobile, would encounter only about a tenth as much air resistance as the average automobile encounters now." He very sensibly adds that such perfection "is probably beyond the possibilities of this finite world," not only for reasons of "style" but also because a 90 per cent gain in efficiency would be appreciated only at far higher speeds than are demanded in routine driving — or on present highways. A further technical difficulty, and one from which the airplane is free, lies in what is called "underbody turbulence": the peculiar type of eddies and currents set up between an irregular road surface and the lower part of the car. Walter Dorwin Teague, Jr., son of the well-known designer, W. D. Teague, and himself a keen student of these, and related, problems, has pointed out that the mathematical and physical factors of underbody turbulence are far from being solved, and that the necessity for a minimum clearance between the road and the lower part of the chassis will impose permanent limitations upon streamlining for any form of vehicle that travels on land. Enclosing the exposed chassis parts might help, but to do so would entail further engineering problems connected with ventilation, oil and fuel supply, emergency repairs, etc.

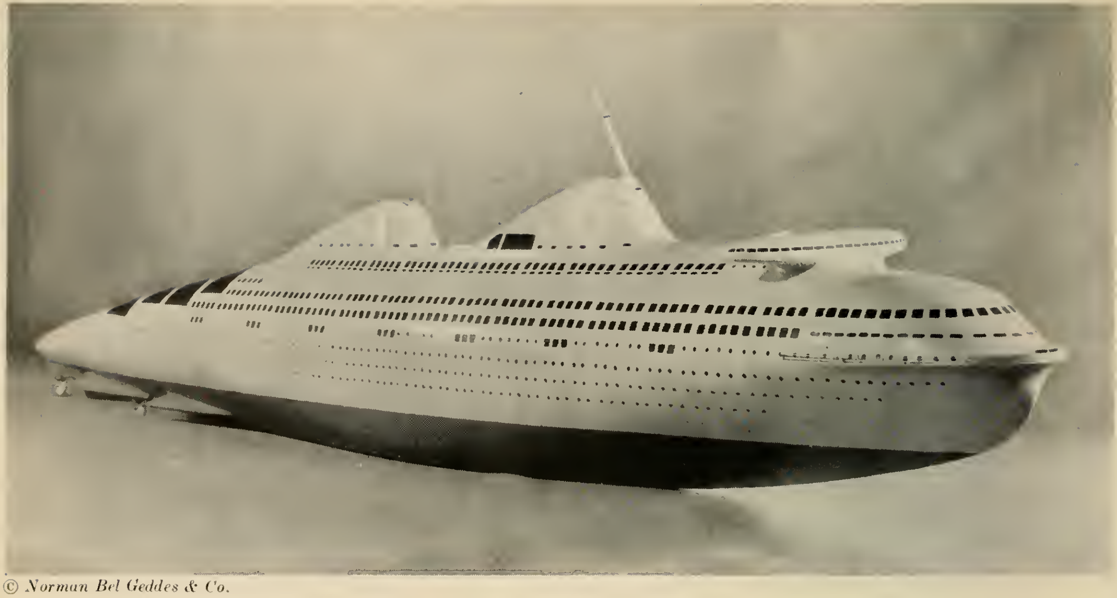
EFFECTS OF WIND AND AIR CURRENTS

Actually a sedan automobile of the type which most of us see, drive, or ride about in, is wasting a full half of its power at 30 miles an hour in overcoming wind resistance. Nasty little air currents churn around the radiator, maul the windshield, whistle along the protruding fenders — and whirl in a thousand suction vortices behind the truncated rear end. Increase the speed to 70 miles an hour and five sixths of your gasoline bill is paid out for the same purpose. No wonder streamlining, from golf sticks to transatlantic liners, has become more than a passing fashion! Fuel and lubricating costs alone would compel such developments: as may be realized from the fact that, in order to increase its average rated speed by *two knots* the great Italian liner "Rex" had to increase its daily fuel oil consumption from around 700 to 1100 tons of oil. This meant a fuel cost alone of $5000 a day, spent in the work of churning up wind and wave around the colossal hulk!

Current streamline practice in automobiles is somewhat retarded by public hostility toward revolutionary innovations. To this must be added the high economic cost of redesigning machinery and factories to produce acceptable streamline models. Nevertheless, a manufacturer here and there is moving toward this end and, thanks largely to the airplane, things are getting better. One of the great pioneers of aërodynamics, Gustave Eiffel (none other than the builder of the famous Eiffel Tower) began, twenty years ago, to study the effects of air and wind currents on automobiles, locomotives, railway coaches, and primitive airplanes. For this purpose he built perhaps the first of those "wind tunnels" which today are scattered all over the world — we in this country, in the Daniel Guggenheim Foundation, have one of the finest — and from which we have learned so much about how to improve our transportation. Much later the British Admiralty, seeking for the best models to use in constructing airships (and submarines!), investigated the life habits of numerous aquatic animals, from tunny and salmon grilse to the blue whale. From these studies the fact emerged that the finest examples of natural streamlining were to be found in the last-named — and in the shark: both of these, their lines somewhat rearranged, were adopted in experimental automobiles.

PROBLEMS OF AUTOMOTIVE ENGINEERING

A very thorough research on the automobile, based on wind-tunnel measurements, was conducted by R. H. Heald, of the United States Bureau of Standards. Mr. Heald took six small-scale models of motor cars: a 1922 sedan, 1922 touring car, 1928 light sedan, 1933 light sedan, and two models constructed according to streamline principles. Measuring the wind resistance on each of these models at a standard velocity, the following "drag coefficients" were determined: 1922 sedan, 0.0017; 1928 sedan, 0.0018; 1933 sedan, 0.0014; streamlined model, 0.0005. In other words, a car designed according to correct aërodynamic principles is nearly 350 per cent more effi-



© *Norman Bel Geddes & Co.*

(Above) Norman Bel Geddes has designed this model of a streamlined ocean liner. Though it is intended for the surface of the water, it is interesting to compare its shape with that of the leopard seal at the right

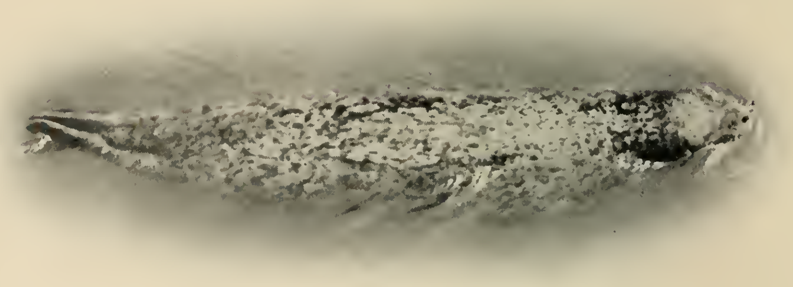
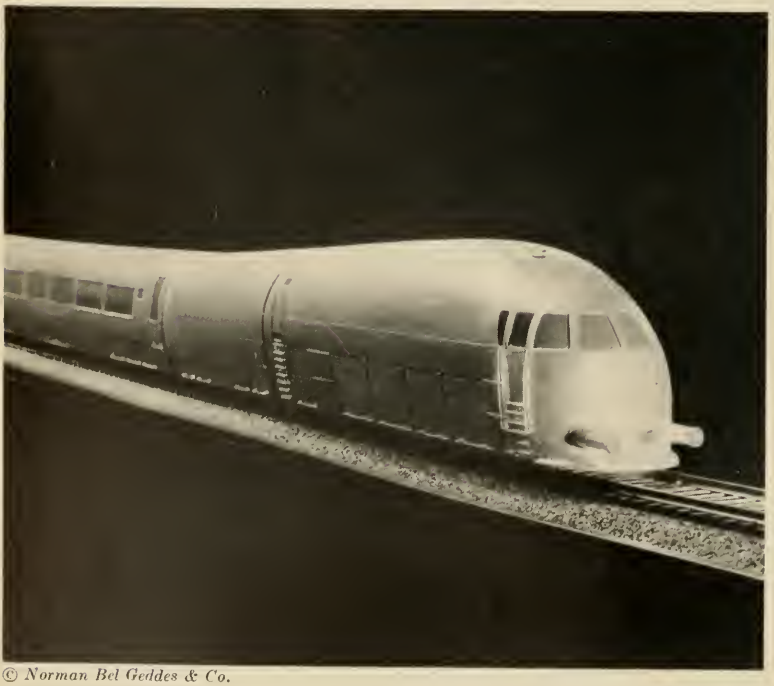


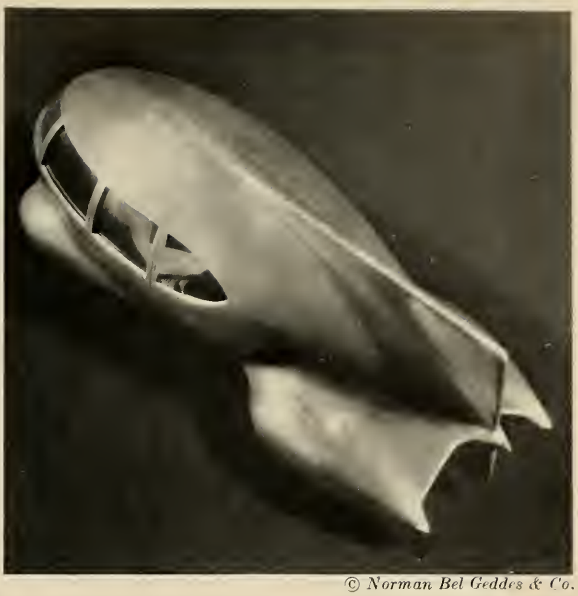
Photo by Robert Cushman Murphy



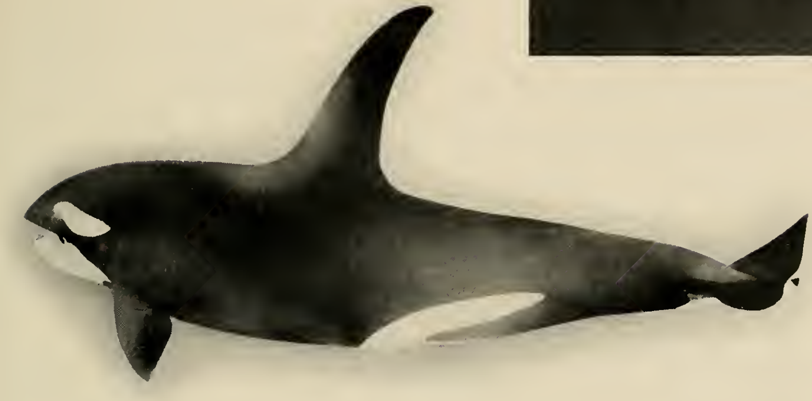
© *Norman Bel Geddes & Co.*

A few years ago the Norman Bel Geddes streamlined model train at the left would, no doubt, have seemed more extreme than it does now, for somewhat similar trains are already in operation

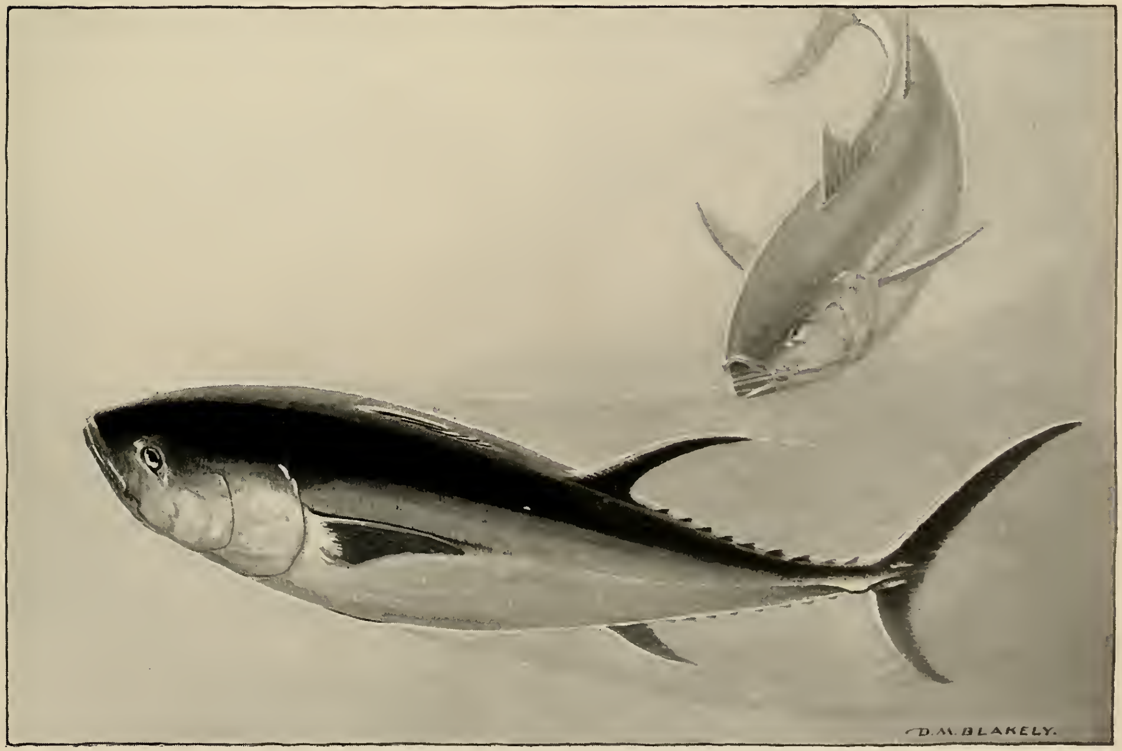
For the most part, streamlined automobiles are not streamlined at all. The model car shown at the right, designed by Norman Bel Geddes, is, however, a suggestion of what must ultimately be done in the matter of automobile design. A major difficulty arises from the fact that automobiles properly designed, for instance, for travel against the wind, are improperly streamlined when the wind blows from any other direction



© Norman Bel Geddes & Co.



The killer whale at the left and the tuna below are outstanding examples of Nature's streamlining. The tuna is the more remarkable, for, at high speeds, the spinous dorsal, the pectoral, and the ventral fins fold against the body



cient in overcoming air resistance than a stock model of eight years ago! Translating the mathematical expressions into more readily understood terms of horsepower, the Bureau of Standards investigation means that at a given speed of 60 miles per hour, power consumption works out like this: 1922 sedan, 27 HP; 1922 touring car, 33 HP; 1928 sedan, 26 HP; 1933 sedan, 18 HP; *two streamlined models, 8 and 6 HP* — a 300 per cent gain in efficiency over the best of 1933's cars, and nearly 600 per cent over a heavy 1922 touring car. It must be remembered, of course, that these were essentially laboratory tests: operation under actual road conditions would considerably change these ratios. But, as the changes would affect *all* the models, the relative superiority of the specially designed models would remain. Nor must one forget another disturbing factor in attaining high speeds: "Cross" or "quartering" winds. On this subject the analysis made for the writer by W. D. Teague, Jr., is worth careful attention, for it clearly summarizes one of the best-known problems of automotive engineering.

Mr. Teague states:

> One difference in the streamlining of an automobile and an airplane is the effect of "cross winds," or wind currents striking the car from various angles in front. A perfect teardrop shape is designed for maximum efficiency when moving straight ahead, but it is not the most efficient shape when moving in any other direction. When a wind strikes an automobile from a quartering angle, the result is the same as if there were no wind and the car were moving partly sidewise.

This difficulty, of course, is reduced to a minimum with a properly streamlined submarine moving at depths below the turbulence range of waves, or with an airplane "schooning" at high altitudes. In each case the vehicle is completely surrounded by an elastic medium as nearly homogeneous as it is possible to realize, and the chief problems of the designer are those of weight distribution, power plant, surface area (which includes all excrescences) and "skin friction" — the unavoidable rubbing of the vehicle's body against the contact layers of the medium.

Thanks to the tremendous development of commercial aviation the whole problem of mass-transportation both on land and water has been torn wide open. The great shipping lines are fighting desperately to regain a passenger traffic which is, as yet, but slightly threatened by trans-oceanic air service though, paradoxically enough, they are doing this on the basis of size, paying far too little attention to the basic problems of design. Norman Bel Geddes, whose ideas on streamlining are so advanced that many practicing engineers tend to smile at them as fantastic, has drawn up plans for liners which resemble nothing so much as gigantic dolphins, blunt-nosed, absolutely smooth sides, with long, tapering tails and finlike funnels clipping the air. He claims that a full-size, 70,000-ton, 1000-foot ship built according to his specifications could achieve a 20 per cent increase in speed over the orthodox design, adding 5¾ knots to the present average rate, thus clipping 22 hours from the cruising time between New York and Plymouth. The streamline features are believed to reduce the factor of wind resistance by as much as 14 per cent — and this gain would be increased in bad weather owing to the general structure of the ship. Furthermore, Mr. Bel Geddes claims that the costs of construction — as well as of operation — would be considerably less than at present.

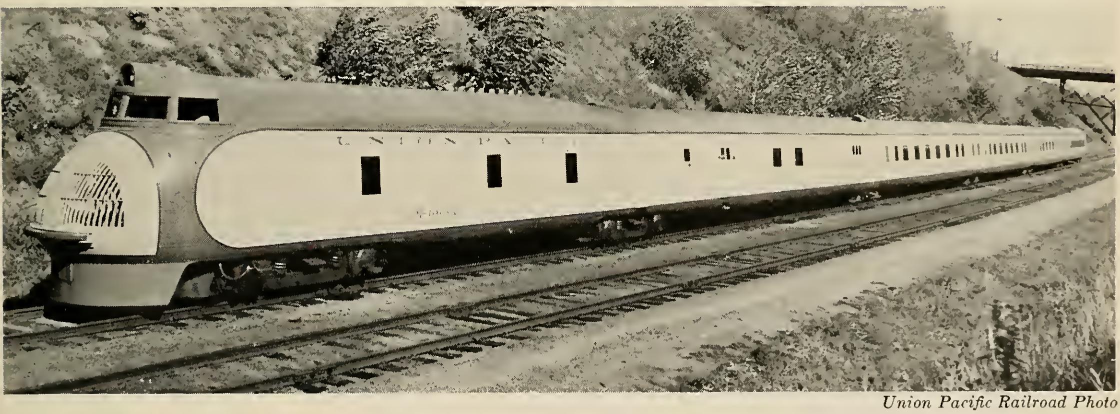
Possibly. But in the time it would take for the shipping companies to effect such drastic, and costly, changes in their existing practices, and to "educate" a traveling public to cross the ocean in the new contraptions — in that time trans-marine air traffic might have become a reasonable possibility.

On land, however, there will always be the railroads: though, on this subject many a railroad executive, scanning his year's balance sheet, has bitter doubts. From nearly 47 billion passenger miles delivered by the railroads of this country in 1920 to less than 16½ billion passenger miles in 1933: a decline of nearly two thirds in fifteen years — that makes a railroad tragedy of the first order. Couple this fact with an *increase* in automobile registrations during the same period of from 8¼ to more than 23 million — a 250 per cent increase — and you have one of the reasons for this tragedy.

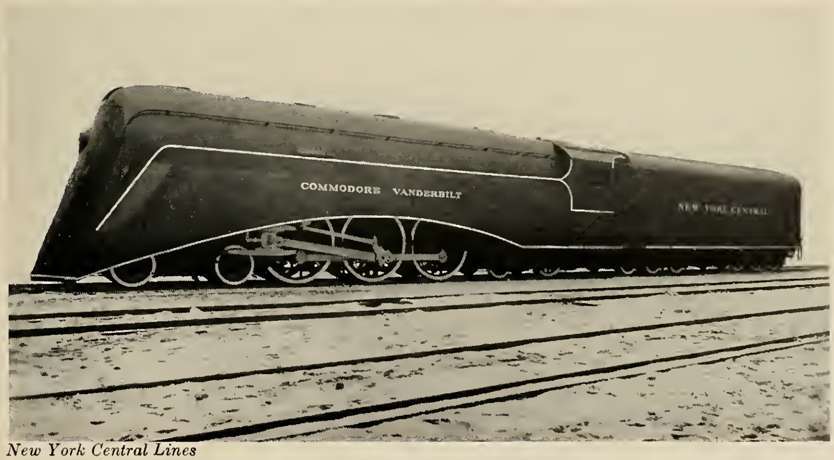
The porpoise above again illustrates Nature's streamlining, while the dirigible at the left probably illustrates one of the most perfectly streamlined forms that has yet been developed for practical use by man

Official Photograph, U. S. Navy

Aeronautical Chamber of Commerce of America



Union Pacific Railroad Photo



The Union Pacific train shown above has been so designed as to eliminate a large part of the wind resistance encountered by trains of usual design. The New York Central locomotive shown at the left has been fitted with a partly streamlined covering in order to accomplish a similar purpose. That such changes in shape are beneficial is not to be questioned

New York Central Lines

One way out is: move less traffic at higher speeds and less unit cost, over greater distances in less time. This solution leads as straight as an arrow to an assorted collection of technical improvements, of which streamlining is by no means the least important. Result: what Henry F. Pringle has called "Tomorrow's Trains," and what not a few of us have seen, pictured or in reality, in the Burlington "Zephyr" and in the Union Pacific 80-ton, six-car aluminum unit now in active service. Regarding this latter achievement of modern land transport, we can do worse than listen to the aëronautical engineer who supervised the wind-tunnel tests on which the final blueprints were based and in whose opinion the new train "has possibilities of power economy not possessed by any other known vehicle." He wrote:

> The new train will require 500 HP to propel it 90 miles per hour with a load of 120 passengers and 25,000 pounds of mail and baggage. The ten-car conventional train which it replaces [average weight, 1000 tons] carrying the same load at the same speed, requires 3400 HP; a three-car conventional train requires 1700 HP; six buses, similarly loaded, same speed, 1500 HP; 30 automobiles, 3600 HP; a steam river-boat, 211,000 HP; and 13 transport airplanes, 5000 HP.

For each of the 120 passengers on a ten-car conventional train the locomotive has to pull an additional weight of 8.3 tons, at an average total operating cost of one dollar a mile, and a power expenditure per passenger of 28.3 HP. Enter the engineer with carte blanche to design and construct a practicable transport unit running on its own track by electric power supplied from its own Winton-distillate engine power plant. Each passenger can now travel, at the same speed, on considerably less than five HP, carrying with him additional weight of about *seven-tenths of a ton*, with a total operating cost which should not be much in excess of forty or fifty cents a mile. (The fuel burned in the Union Pacific, and similarly designed trains, will not cost much more than four cents a gallon — and one gallon will drive the unit, fully loaded, for something more than a mile.)

No wonder the railroads are waking up to some of the laws of Nature, as exhibited in the phenomena of aërodynamics! Those companies which are not yet able, or willing, to make 100 per cent changes in their present equipment (much of which, be it remembered, has still to be paid for — and pay for itself) are messing around with minor changes, like the New York, New Haven and Hartford with its redesigned coaches. And builders of steam locomotives — notably the American Locomotive Company — are doing their best to reconcile the discovery of James Watt with the imperatives of the aërodynamic engineer: with every chance of at least moderate success, according to the already completed designs of the above-named Company: which is convinced that a properly streamlined steam locomotive can attain speeds of 90 miles per hour with an over-all weight per passenger of about 500 pounds!

THE SECRET OF SPEED

It is curious to reflect that Man, who is always in a hurry, should turn for the secret of Speed to Nature, who will consume centuries and æons to complete one of her countless voyages through the worlds of matter, animate or inanimate. But, even in Nature, there is a tendency to finish whatever task is under way with a minimum expenditure of energy, materials, and time: this despite the apparent "uselessness" of the final result. Physicists, thinking of the ways of light, electricity, gravitation, have given this tendency a name: they call it "the Principle of Soonest Arrival."

The whole secret of Streamlining is in those words. To arrive first, in a world consumed with the passion for Speed, travel the shortest route in the briefest time. To do these things *efficiently*, reduce to its minimum the resistance of the medium through which you are traveling. In other words, once more: Back to Nature!

Nesting Days

With the return of spring the bird world reawakens, offering the nature photographer infinite opportunities for fascinating observation

By Alfred M. Bailey

Director The Chicago Academy of Sciences
Photographs by the Author and F. R. Dickinson

WHEN drizzling rains of late March have melted the last of the winter snow, the first of the winged migrants makes a leisurely appearance. There will still be many cold days; the forests are drear and the leaves soft underfoot; there is a bite to the steady wind, but here and there in sheltered places, green growths are pushing aside protective mantles. Hardy bluebirds, robins, and meadowlarks have arrived to join the scattered wintering birds, and their cheery calls seem to promise better days ahead. As March progresses into April, many of the seed-eating birds find an easy living under the receding snow. The song-sparrow no longer skulks amid a tangle of vines and grasses, but makes known his joy of living from a prominent perch, while troops of fox sparrows and towhees invade the territory of the resident cardinals.

The great horned owls have long since hatched their youngsters in some towering cottonwood or pine, for they are hardy fellows; they had eggs in late February and now large fuzzy young may be seen huddled together on some outstretched limb, gray against dark shadows, awaiting the arrival of their parents carrying some unfortunate small mammal. Pugnacious fellows are these young horned owls, with glaring yellow eyes and snapping beaks! They threaten dire punishment to the photographer, but their bold front is mere pretense, for they have little strength, as yet, in their great talons.

When we wander through the dank woods in early April and are greeted by the new arrivals, we see many of our wintering guests, of course, and we occasionally hear the wild far-reaching calls of red-shouldered or red-tailed hawks as they cruise high overhead, scanning the world below. What wonderful eyesight they must have to see the small furred creatures upon which they feed! A few have been with us all winter, but occasionally, at this time of the year, one will circle overhead, calling querulously, anxiously, and we know that a nest is near. A platform high up in a tree must be the nesting site; with the glasses we see a solid construction of small twigs with masses of dried leaves, so we pass on, for that is the home of a squirrel. But the nest is not far and we scrape our shins on rough bark as we climb to investigate; four beautifully splotched eggs of the red-shouldered hawk repay us for our visit. There is an ideal spot for erecting a photographic blind in a near-by tree and our spring work is begun.

There are worse ways of spending April days than sitting in a photographic blind, high up in a wind-blown ash. We see the bird world unobserved. Crows call near at hand while our nesting hawk sits close on her nest; nuthatches and brown creepers explore bark surfaces within arm's reach, and a downy woodpecker taps inquisitively at the framework of our blind. Fox squirrels carry on their contretemps, leaping from tree to tree, while far below us a woodchuck feeds on the fast-growing plants.

* * * * *

There came a day when our hawk did not fly from sight on our arrival at the blind; instead she circled the near-by woods, crying piteously. There was a reason, for as we shinned to the level of the nest, we saw a downy little head over the rim. We had hardly crawled within our canvas shelter before the old red-shoulder was on her nest, and with drooping wings and raised crest, hurled invectives at the creatures taking refuge in the blind.

We came to know Lonesome Willie well, in the days that followed. He was named "Lonesome" because he was the sole survivor of two that hatched. Willie grew rapidly on a diet of small mammals, gar-

The spotted sandpiper settles upon its protectively colored eggs among the flowering dogwood

(Left) The pied-billed grebe eyes the photographer from behind a tangle of last year's growth

(Below) The killdeer attempts to hatch a golf ball — an ambitious but futile task

The long-billed marsh wren totes bugs to its youngsters, concealed in the domelike nest

(Right) Least bitterns nest on fragile platforms in the tule marshes and feed their fast growing youngsters upon frogs, crayfish, and other small marsh animals

(Below) When crayfish mounds line the shores of the marshes, it is a sign that the kingrails have started housekeeping

nished with an occasional writhing garter snake, and it was not long before he would walk about the nest, now and then rising to his full height, flapping his wings as he took his morning exercise. When crows came near, Willie flattened out in the nest and remained motionless, and every morning, when the mail plane came droning low over the woods, Willie would crouch until the roar of the motor became fainter and fainter and finally died away in the east.

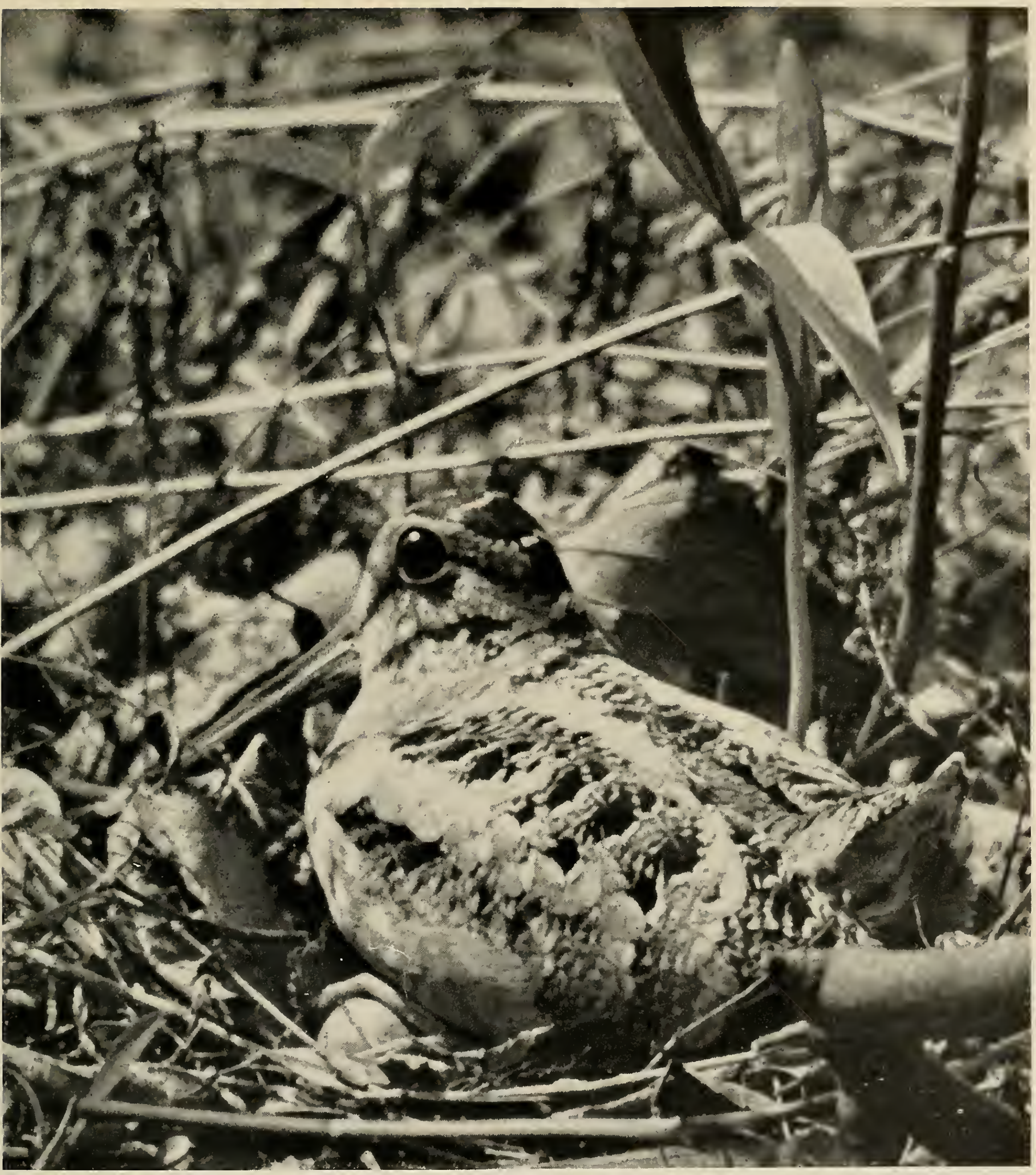
WOODCOCK

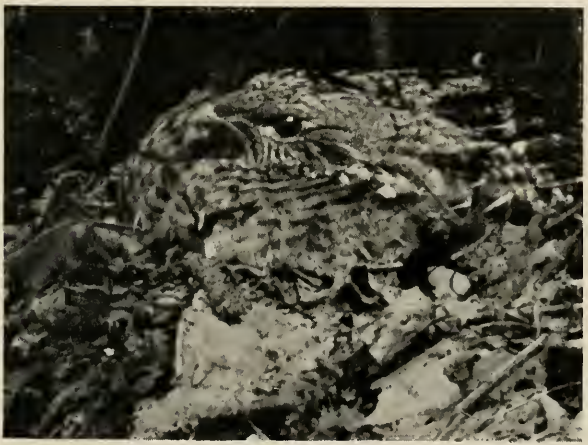
One morning in April, when spring beauties sent waves of color rolling through our wood, and the bushes were tinged with green, we flushed a timber-doodle, that quaint relative of the shore birds that depends for his protection on his coloration and a fast getaway, when closely pressed. This old man of the woods, the woodcock, was so inconspicuous we nearly stepped on him before he burst from underfoot. We knew his bride must be in the near vicinity, so we searched carefully in likely spots, and finally located her crouching on her eggs. Her colors were those of the forest floor, beautiful feather patterns that matched the subdued values of the fallen leaves. Only her beady black eyes, watching intently, betrayed her.

And so, from the time of our earliest nests in March, we find something of interest afield. April is well along and the migrants are passing through to distant breeding grounds and the forests and fields are ringing with the notes which bring back memories of other spring days with companions who no longer share our pleasures. The song of the redwing in the ice-bordered marsh, the whir of wings of the spoonbills, pintail and blue-winged teal as they break from the edge of the little cat-tail pond, and the chorus of unseen frogs, are all events of the day. The bobolinks adorn the open fields; they have just returned from distant Argentine and Patagonia. The beautiful black-and-white males are conspicuous upon dead reeds, while their modestly dressed mates seek favorable nesting sites in the newly grown grasses. The brown thrushes and catbirds build along the hedgerows or among the blossoming crab apples; they are not shy, they sing the day through, having as varied a repertoire as their relative the mocking bird. And while our summer residents are starting housekeeping, the little strangers are continually passing onward; small warblers of many species, vireos, and flycatchers.

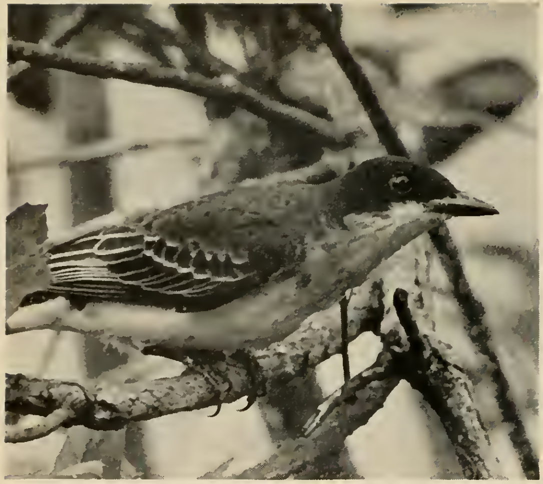
As April is the month when winter turns to spring, so May is the month when spring changes to summer. It is the month of travel and homemaking. Our little song sparrow still sings from his prominent perch, but not far away, in the tangle of grass and fallen branches is a loosely constructed nest, to which the little brown-striped female makes continuous trips, toting bugs of monstrous size to plug the wide open maws of the youngsters. A young cowbird is outgrowing his foster brothers, and as he has a larger mouth and longer neck, secures more than his share of worldly goods. And economists say that times have changed, that things will be equally divided from now on! Or will it work out that we, in our human affairs, will have more cowbirds and fewer song sparrows to tote bugs? Certainly it would not help the young song sparrows if the ruler of the universe should decide that because of upset conditions, we should limit production in the bug world, and reduce the supply available. The cowbirds would continue to get more than their share, due to physical advantage. No, it would seem that if our young song sparrows — human and bird — are to have an abundance of the necessities as well as the pleasures of life, we must produce more instead of less. There is a limit to what a young cowbird can consume, and his nest mates will eventually strike out into other fields where competition may not be so keen.

But one of the delights of rambling in early spring, if one is not of a naturally morbid disposition, is that he can escape from human cares. It is not necessary to draw comparisons between our petty troubles and those of the creatures of the wild. When we hear from a roadside marsh the "couch-ar-ree" of the redwing, a bird full of joy, we may be sure that there are many other species in the same wet area and that there will be a wealth of interesting material





The woodcock (shown above) is an inconspicuous bird with colors like those of the forest floor, beautiful feather patterns that match the subdued values of the fallen leaves. Only the bird's black eyes are prominent. (Left) The ruffed grouse upon her eggs matches the high lights and shadows of the surrounding vegetation. Fortunate indeed is the wanderer who discovers one on its nest



(Above, left) The kingbird tolerates no invaders in his domain. *(Above)* The flicker pauses at the nesting entrance. *(Left)* The nests of the towhees are hidden among the shadows. *(Below)* The robin, a favorite harbinger of spring which is well known to all

(Above) Mourning doves occasionally build their homes upon the ground. (Right) Orchards are favorite haunts of the cedar waxwings. (Below) The vesper sparrow dwells on the ground. (Below, right) Prairie horned larks are seen about such open spaces as golf courses

(Left) The screech owls nest in the willow stubs along a meandering stream. The melancholy calls of these birds seem to come from all parts of the woods

(Below) The red-shouldered hawk is a beneficial species, for it feeds its young almost exclusively upon small mammals, with an occasional garter snake for dessert. The nest is usually placed in a crotch of a tall forest tree

to study. On warm days in early May when the rapidly growing cat-tails are a foot or more in height, we find the painted terrapins and water snakes sunning themselves on water-soaked logs, the frog chorus is at its height, and along the shores of our little pond we find mounds where the crayfishes have deposited mud from their tunnels.

We know that the pied-billed grebes are nesting though we have failed to see a bird, for these shy creatures are adept at hiding. Near at hand, partly concealed among the marsh growth is a small floating mound, like the submerged top of an old muskrat house. Carefully removing the débris we find the dirty white eggs of an "hell-diver." The old bird had concealed the eggs when we splashed into sight, and even now, is undoubtedly eyeing us from behind a tangle of last year's growth. A short distance away, well hidden in a mass of old reed is the nest of a coot with eight speckled eggs, and the old one protests plaintively from a distance. The marshes are a delight at this time of the year for there is an abundance of life to be found in a limited area; there is no difficulty in discovering the homes of the nesting water fowl. On her little reed platform an American bittern sits motionless with long neck and beak extended upward so that she resembles the stalks of the surrounding plants. Her bright yellow eyes watch every move we make, but if we pretend that we have not seen her, we may walk within touching distance.

Our little grebe and the coots do not object to our prying into their affairs, however, and soon after we have concealed ourselves in a little canvas shelter, they come from their hiding places, timidly advancing toward their nests.

A few weeks later, well after the middle of the month, when the tules and cat-tails are well along, we find that the rails have started housekeeping. When we saw the crayfish mounds along the shore, we knew the king rails would be nesting, as well as their smaller relations, the Virginia rail and the sora, for the crawfish is a preferred article on the menu of these wary creatures. These birds present no problem to the photographer, however, for though they skulk timidly among the water plants, they do not seem to mind a photographic blind and return quickly enough when all is quiet, even though it has been erected in their very dooryard. We have no difficulty in recording their nesting activities.

The marsh dwellers are now in the midst of their housekeeping. The black tern and Forster's tern deposit their eggs on frail masses of decayed vegetation, and while one incubates the splotched eggs, the other cruises over the gleaming waters, in company with many of his kind, searching for food and finding fault with all the other inhabitants. In fact, it seems to be a habit of the majority of marsh-nesting species to be intolerant of their neighbors. The tyrant kingbird living in the willow overhanging the water tolerates no invaders in his domain; no hawk or crow is going to pass his precincts without being hurried on his way by vicious onslaughts from above. Even the tiny long-billed marsh wrens, busy carrying bugs to youngsters concealed in domelike nests, resent intrusion. They protest violently if the least bittern, gliding through the tangled vegetation, ventures too near their home. This little heron is inoffensive enough; he is merely returning to his nesting platform with its awaiting chicks; he is heavily laden with small frogs, fishes, and other delicacies which he has caught and swallowed, and the young epicureans are impatient for his arrival. So there is no reason for violence on the part of the wrens; it is merely that the various pairs of birds have title to a certain amount of ground and trespassers are warned that they poach on the hunting preserves at their own risk.

And so, we find the activities of the birds of marsh, forest, and field at their height. During the fall and winter months they lived a carefree life, but now they are tied to one locality by that instinct which impels the individual to attempt to perpetuate its kind. They are no longer free agents, they must remain at home, and consequently, if we desire to become acquainted with our feathered neighbors, the time for us to roam afield is in the spring and summer, when the days grow long.

Building a Super-Giant Rhinoceros

The problems encountered in reconstructing from fragmentary remains the skeleton of Baluchitherium, a gigantic, prehistoric rhinoceros

By William K. Gregory

Curator, Department of Comparative Anatomy, American Museum

Contrary to a widespread popular belief, scientists are unable to reconstruct an otherwise unknown animal from a single bone. The following article gives some idea of the difficulties encountered even when many bones are available, though the varying sizes of the individual animals from which, in this instance, the bones came, complicated the matter considerably. That they have been able, however, to reconstruct a "new" animal of extraordinary size and unusual interest is obvious. The scientific results of this work are being published by Walter Granger and William K. Gregory in the American Museum Novitates and Bulletin. — The Editors.

EZEKIEL'S vision of the valley of dry bones came again in our days to Henry Fairfield Osborn, who prophesied concerning the valleys of dry bones in Asia. And he sent thither his young men, the keepers of his behemoths and the masters of his leviathans, and they went forth into the desert places. And when they went down into the valleys of the desert, lo, the bones were buried in the rock. And they searched far and near and looked hither and thither, and behold, the valleys were full of bones, and lo, they were very dry. Then the prophet girded up his loins and went down himself after his young men into the valleys of dry bones. And he came upon a small bone by the roadside and he prophesied and said: Thou shalt be called *Eudinoceras*, because thou art the father of all those whose horns are exalted upon their foreheads. And the bone answered and spake unto him, saying: "My lord, thou sayest it." And he prophesied again and said: "Come forth, O bones, from thy rocky sepulchres!" And lo, there was a sound as of many picks and spades and the bones came forth out of the rocks and the bones came together, bone to his bone. And when he had prophesied yet again they stood up upon their feet, like unto giants. But the greatest of them all was *Baluchitherium*.

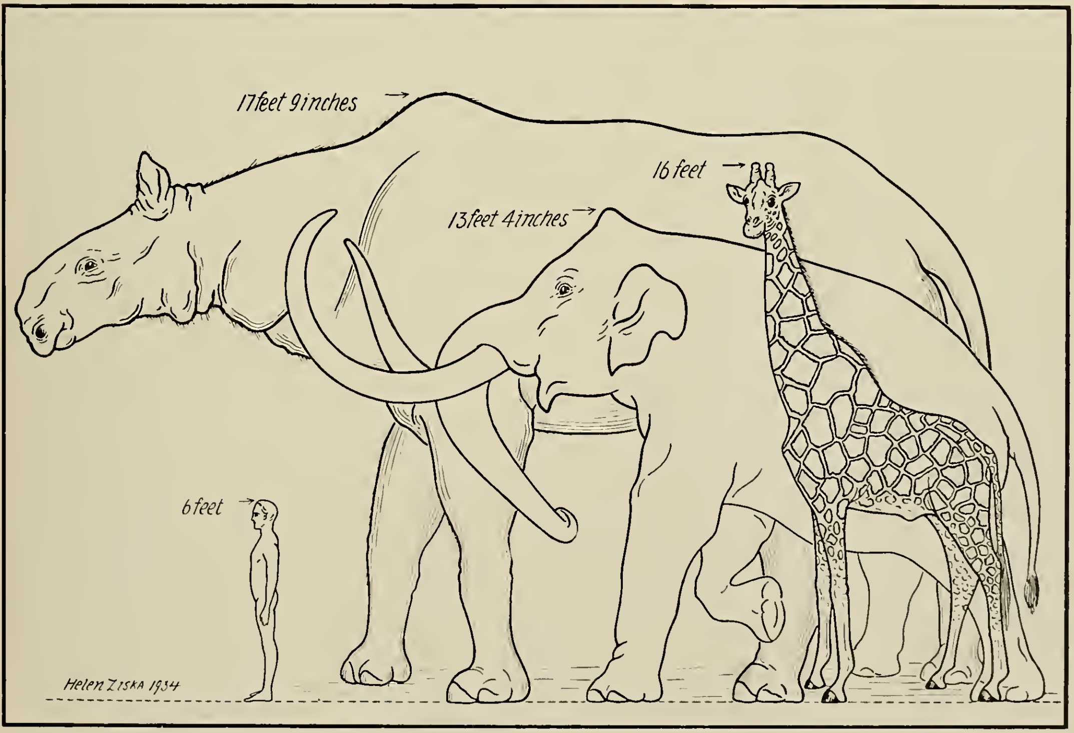
Dropping the parable and coming down to the dry bones of fact, we may begin our chronicle of *Baluchitherium* with the year 1909, when Mr. C. Forster Cooper, then a graduate student of Cambridge University, came to New York to spend a year studying palæontology at the American Museum of Natural History under Prof. Henry Fairfield Osborn, and caught the vision of the valleys of dry bones in Central Asia. Thus it was that Mr. Forster Cooper was willing to risk exposing himself to the usually accurate marksmanship of the vigilant tribesmen of Baluchistan for the sake of opening up to science their undiscovered palæontological treasures.

Accordingly in 1910 and 1911 he made two journeys into Baluchistan and succeeded in finding and bringing out a number of new and important fossils, including the jaws of some very large extinct species of rhinoceros and a few bones of truly Titanic size and unknown provenance. The enormous atlas vertebra of this form somewhat resembled that of a horse and so did the middle bone of the forefoot. The astragalus, or pulley-bone of the ankle, however, was more like that of a rhinoceros, while the huge thigh bone in some ways suggested that of an elephant. Most remarkable of all, the sixth vertebra of the neck was so big that, when boxed, it made a full load for a camel. Although in some features resembling that of a horse, it had great "caves" on either side of the centrum, or basal portion, beneath the tunnel for the spinal cord. This was a feature hitherto unknown in the vertebræ of mammals but common in the vertebræ of the huge sauropod dinosaurs. Mr. Cooper considered these "caves" as adaptations to secure lightness combined with strength, and they were obviously not indicative of relationship with dinosaurs.

On the basis of these and other facts he rightly concluded that he had discovered a new member of the ancient and honorable order of Perissodactyla (odd-toed hoofed mammals, including tapirs, rhinoceroses, and horses); but he believed at that time that the giant was also quite distinct from the rhinoceroses although perhaps remotely allied with them.

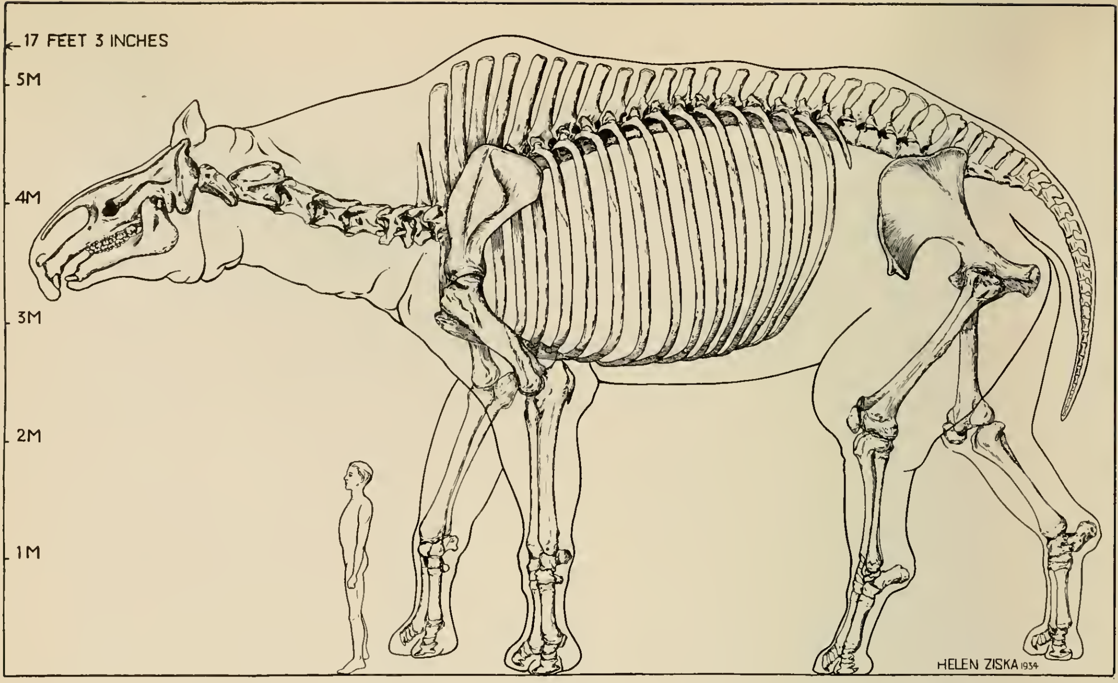
Since it was his well-earned right to give a name to this extraordinary animal, he named it *Thaumastotherium osborni*, literally "Osborn's Wonder Beast," in honor of his friend and teacher. It was soon pointed out to him, however, that the name *Thaumastotherium* had already been "preoccupied" for another fossil and was therefore unavailable according to the rules of nomenclature. He accordingly changed the name of the genus to *Baluchitherium*, the species remaining as before.

In 1914 a Russian soldier who was also a student of geology discovered some Titanic fossil bones in Turgai, a part of Russian Turkestan, and these were eventually collected and set up in the Moscow Museum and described under the name *Indricotherium asiaticum* in 1915, 1922, by Professor Borissiak. This material included a palate with well preserved premolars and molars, which showed beyond doubt that *Indrico-*

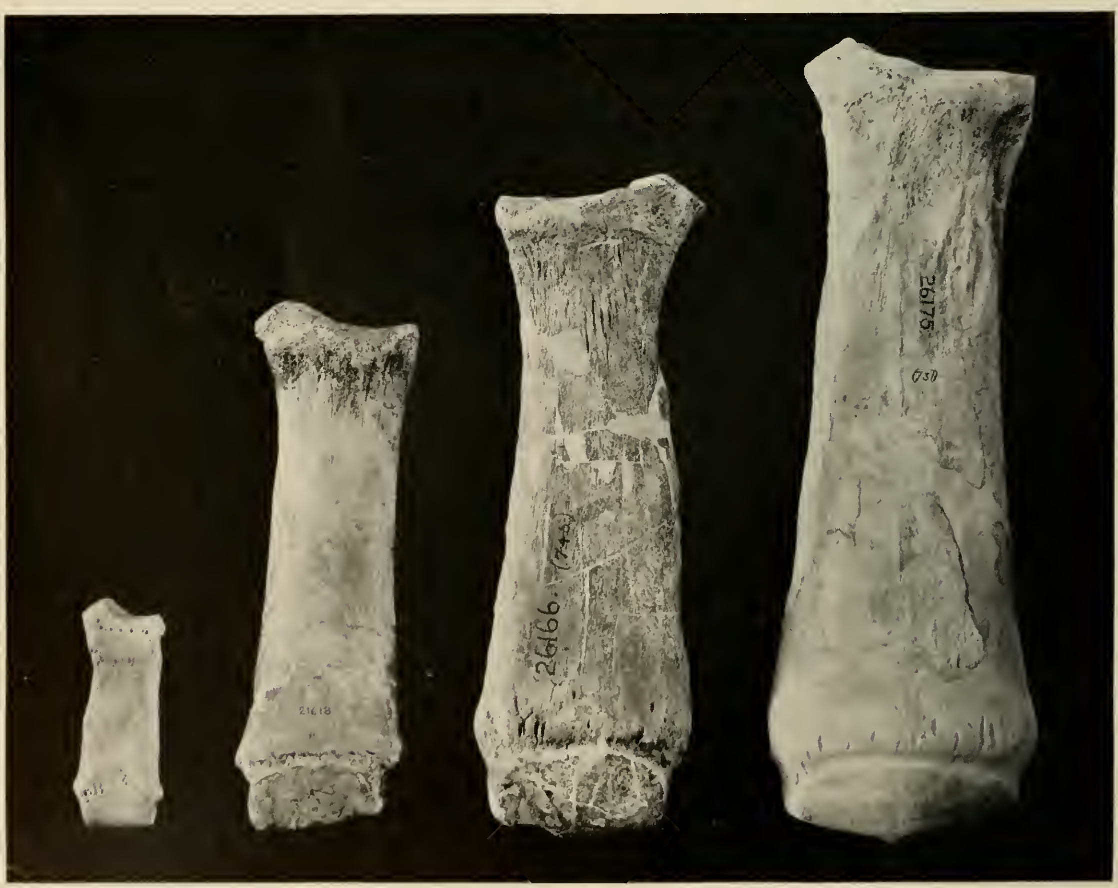


A Comparison

This drawing, made to scale, shows the comparative outlines of the largest Baluchitherium (as restored), the largest fossil elephant (Archidiskodon maibeni), *and a large modern giraffe. Drawn by Mrs. Helen Ziska*


17 FEET 3 INCHES
5M
4M
3M
2M
1M
HELEN ZISKA 1934

The restoration of the skeleton of Baluchitherium, as completed by Walter Granger and William K. Gregory. Drawing by Mrs. Helen Ziska


21618
26166.
(743)
26175

The small bone shown at the left in the photograph above is the middle metacarpal bone from a modern white rhinoceros. The others are the corresponding bones from a small, a large, and a super-giant Baluchitherium. The largest of these is twenty-five inches in length *therium* was a giant rhinoceros, related more or less closely to the earlier hornless rhinoceroses of North America. Later evidence indicated that *Indricotherium* is at least closely related to *Baluchitherium* but the crown pattern of its fourth upper premolar is slightly more complex.

In 1922–30 the Central Asiatic Expedition under the leadership of Roy Chapman Andrews, with Walter Granger in charge of palæontology, found many scattered bones of *Baluchitherium* at various places in the Gobi Desert. The most outstanding find was an incomplete skull, about four feet, three inches, in length, which was described by Professor Osborn in the American Museum *Novitates* (No. 78, May 25, 1923). In this article a preliminary sketch restoration of the skeleton was attempted, in which Forster Cooper's specimens of neck vertebræ and limb bones were combined with the new skull. The rest of the backbone was conjectural, as well as the length of the neck, the height at the shoulder, and the total length of the animal.

In 1933, when the last of the huge *Baluchitherium* bones had been cleared of the matrix, Professor Osborn generously placed the entire collection in our hands for comparative study, together with casts of the most important specimens of Forster Cooper's and Borissiak's material, which had been presented to this Museum in exchange for casts of our skull. We also had constantly before us the well illustrated memoirs of Forster Cooper and Borissiak. Our special purpose was to gain a more accurate knowledge of the skeleton as a whole and to attempt still another provisional restoration of the skeleton which may serve until future discoveries make possible closer approximations to finality.

For nearly a year we struggled with this problem of evolving a consistent restoration of the skeleton out of many odd lots of bones belonging to what, for the sake of simplicity, we finally graded as sizes I, II, III, IV, in descending order. We found eventually that if we multiplied the length of a given bone of No. IV size by 1.4, it would equal the known length of a corresponding bone of No. I size, and that even our No. II grade bones had to be enlarged by 20 per cent to fit with our No. I bones. All the drawings of the individual bones were made to one fifth natural size and the smaller grades were then enlarged by the appropriate factor. But, when all this was done, we still had to make hypothetical restorations of a good many of the vertebræ, we had to determine the probable height of the animal at the shoulders, the length of the neck, the distance between the fore and hind limbs in the standing pose, the height at the pelvis, and many other important measurements. Literally scores of trials were made, checked back and forth against the available facts and then rejected or modified. In other words, the method of trial and error was followed through long and often discouraging months. A less willing and indefatigable artist than Mrs. Helen Ziska would have balked at filling many portfolios with trial drawings, while a less skillful artist could not have fitted together so convincingly the drawings of bones of originally different sizes.

In the later stages of the restoration we began to pay attention to the probable outlines of the body, with due regard to certain given anatomical landmarks that were visible in the bones. Here we reasoned that since the teeth and many individual bones show that we have to do with a fairly primitive rhinoceros, it is highly likely that the skin characters and even general contours were at least distinctly suggestive of a generalized rhinoceros type, but with long limbs and a relatively small head. In fact, our restoration is more definitely rhinoceros-like in almost every feature than were the restorations either of Borissiak or Osborn.

In conclusion, we expect to hear even many times more the oft-quoted remark of the farmer who said of the giraffe, "There ain't no such animal." And we likewise expect to be told that the head in our restoration is impossibly small, the neck not long enough to reach the ground, the scapula absurdly small, and so forth *ad lib.!* But although welcoming constructive criticisms, we respectfully invite qualified critics to spend a year or two in making a new and better restoration from the same material.

Trailside "Talking" Pools

How a stream and a series of pools have been made to tell their own story and the stories of the life that they support

By William H. Carr

Assistant Curator, Department of Education, and Director, Trailside Museums, Bear Mountain, N. Y.

THERE is a quiet brown pool, in the woods, where our Nature Trail passes. Hemlock branches shade the water, and a compact growth of dogwood, sassafras and witch-hazel screens it from a great highway that runs near by. The little pool is fed by the deep waters of Hessian Lake, lying above in the shadow of Bear Mountain. The overflow journeys onward and down to meet the Hudson River less than a quarter of a mile away.

This small body of water is a very important exhibitional feature in the scheme of the Nature Trails and Trailside Museums which have been operated for the past eight years by the American Museum of Natural History in coöperation with the Palisades Interstate Park Commission. Many animals are born and nurtured in the still water. Numerous plants line the pool's margin, attracted and sustained by the moisture upon the banks. In our attempts to tell a rounded story of the natural history of the region, for the benefit of thousands of visitors, we have exploited the brown pool in many ways.

To us the pool represents not only a graceful spot of natural beauty, a cool retreat on warm summers days, but also a place where we may secure specimens for our aquariums and food for various captive animals. We have placed labels here to tell strollers of the life to be found in the pool and, in addition, have outlined upon other labels a brief account of the work of small ponds and streams in general.

Of the many hundreds of similarly attractive pools in the confines of the Palisades Interstate Park, this one alone has been singled out for informational purposes. It is a "talking" representative of all the others. When we print signs about the pool, we realize fully that our writing is far less eloquent than the language of the pool itself. Nevertheless, we also know that nine out of ten of our visitors will fail to observe the pool in any objective way unless we make some attempt at interpretation.

From the standpoint of visiting children and adults, we have discovered that of all the pool inhabitants, none hold more exalted rank than the frogs. They possess, in a remarkable way, the key to the very spirit of both running and quiet water. Ever alert, ever watchful, they are symbols of the pool s mystery. The pool is their host and they its regiments of humble, loyal dependents. These wearers of glistening green and black and gold provide not only color and action, but also, at certain seasons, give musical performances against the perpetual background of the singing stream above.

Nearly all of our Nature Trail walkers who are in any way interested in the pool's residents are content with simply watching the green frogs and the bullfrogs. Oftentimes, however, the frogs are encouraged to jump, and sometimes our guests feel the urge to capture them and to observe, at close hand, their brilliant eyes, webbed feet, and pulsing throats.

It seems to us that we are ever observing creatures of various sorts, in direct relation to the reaction they bring about in the minds of people. It is a fascinating and endless subject for study. In this connection we have often asked the question, "Why is it that a boy can seldom be satisfied with merely looking at a frog?" It is a well known fact that he is not. Many pages could be written to tell the number of different things boys have done to frogs; and then the story would not be complete. Also, many things would not be printable.

There was a particular frog in our pool that tempted one small boy to devise a scheme for testing its actions under conditions of his own making. It was a large, comfortable bullfrog that had an amphibian personality all its own. To human eyes its outward appearance of contentment and

The artificial pools at the Trailside Museum, Bear Mountain, are useful teaching adjuncts. The turtle pool (above) with its overhanging stones, confines the reptiles in a small area. The frog pond (left) serves to bring amphibians to public attention. Photographs by Thane Bierwert

Pond

The infant painted turtle, at the left, behaves very nicely in an aquarium. However, it would probably prefer being at home in a pool such as the one shown below

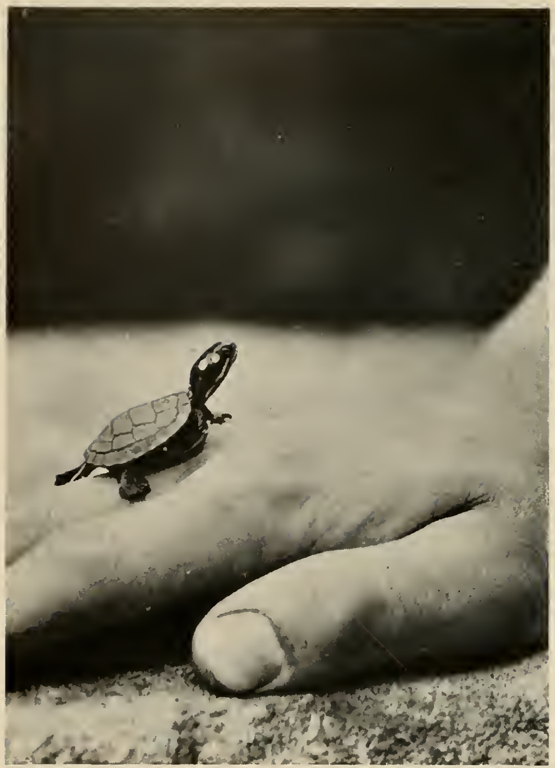


Photo by Thane Bierwert

The pickerel frog below spends long hours in the grass beside pools. The box tortoise below to the right is a terrestrial wanderer

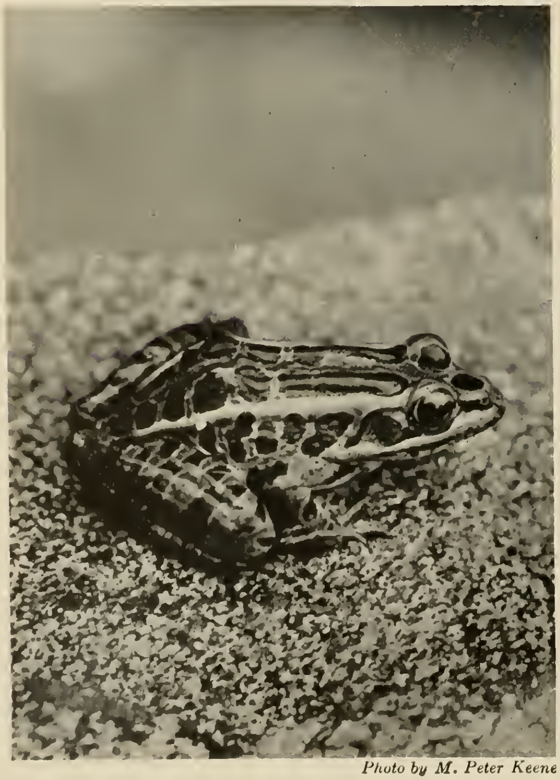


Photo by M. Peter Keene

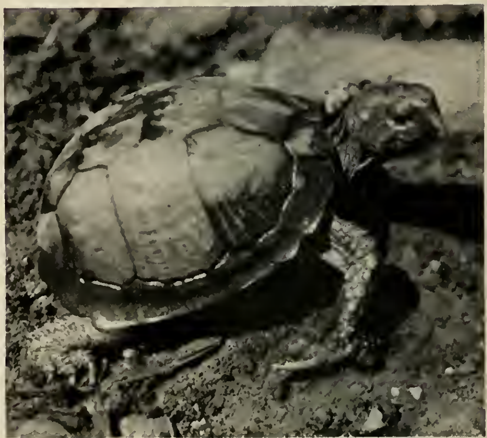


Photo by M. Peter Keene

Life

Young pickerel are splendid aquarium exhibits. They are ever alert, vibrant, and active, feeding readily and living well and attract the attention of many visitors at the Trailside Museum

Photo by M. C. Dickerson

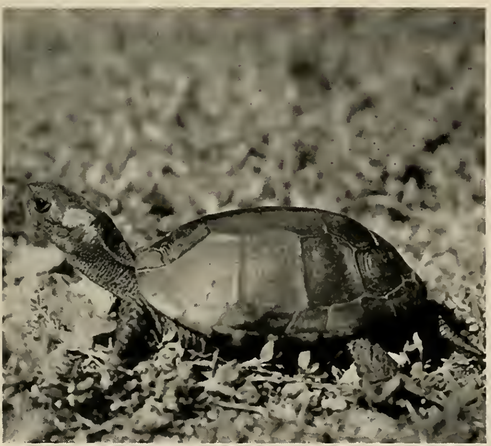


Photo by M. Peter Keene

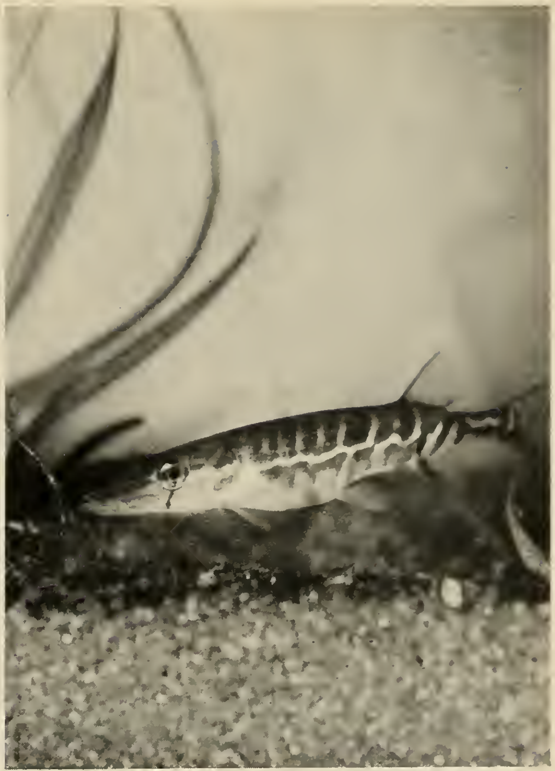


Photo by Wilfred Miller

The watchful bullfrog below is a resident of many natural pools. The Muhlenberg turtle to the left, below, is a rare inhabitant of Bear Mountain

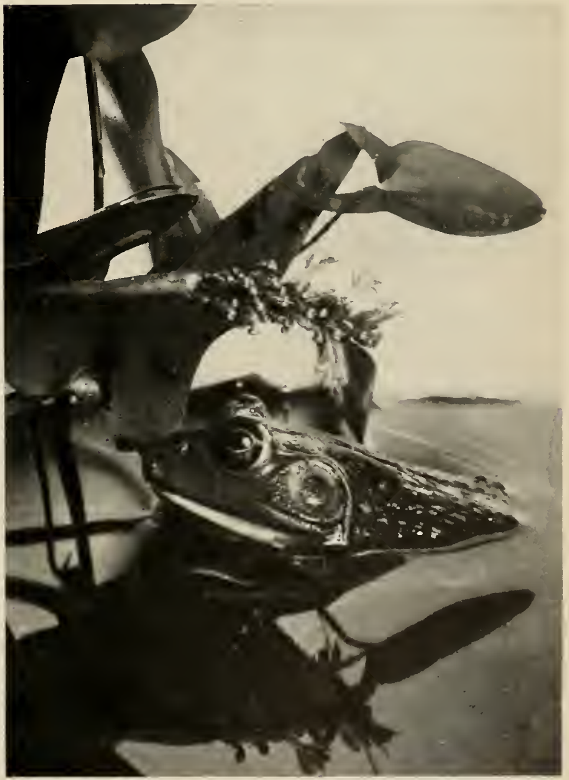


Photo by M. C. Dickerson

ease enabled it to present a calm, self-satisfied demeanor to all the world as it sat motionless on the grassy bank. After having watched the frog for awhile, at fairly close range, the boy conceived the notion of interfering with its unexciting peaceful contemplation of the pond. He held a light branch with a delicate twig at the end. Reaching forward very gently, he tickled the frog's head with the twig tip, expecting of course, to see the animal leap with a splash into the water as many frogs had doubtless done on similar occasion and under like persuasion. This individual, however, apparently had different thoughts than the majority of its fellows. At first, with considerable deliberation, it pushed the twig away with one of its forefeet. It had every appearance of being a dignified and annoyed old gentleman, brushing away flies.

A BEHAVIOR EXPERIMENT

The boy persisted in his tickling tactics until eventually the bullfrog, tired of "brushing," closed its eyes and with complete resignation lowered its head to escape the offending twig, but to no avail. Suddenly, the pestered one's eyes opened, up came its head, and with a lightning-like movement, it bit at the twig, caught it in its mouth, held on for a second, and then released it again.

In his amazement at the stick-biter's totally unexpected performance, the boy dropped the wand and stood gazing at the now unmolested frog. Was it any wonder then, considering the success of the "experiment," that the boy should seek new trials for his frog? If it would deliberately bite a stick, what else might it do? Near the pool's edge grew a small flower with pink petals. Picking one of the vivid petals and impaling it on a long blade of dried grass, the boy waved it gently before the frog's nose. It looked surprisingly like a fluttering insect.

The aroused frog must have had the same idea as to its appearance. It seemed a tempting insect, blown by a kindly breeze. The bullfrog watched its vibration for a moment and then, with a flying leap, grasped it in his mouth, freeing it from the grass-blade, and calmly proceeded to swallow it! Then, as though duties called elsewhere, the frog blinked, gave a leisurely jump, and was soon swimming away out of sight beneath the water, leaving the boy upon the shore very much pleased with himself.

Youthful experiments of this sort interest us nearly as much as do the ones of learned investigators. Perhaps this is a sad admission, but it is true.

If the frogs are the nimble acrobats and witty members of the pond family, then the turtles are its placid, serious and unobtrusive dwellers in water and out. Spotted and painted turtles are at home, both in the Trailside pool and down stream in a small swamp. Despite their somewhat stolid natures, turtles are often difficult to approach, whether from the bank or from some partly submerged log.

On more than one occasion we have come upon visitors, not always young, in pursuit of our turtles. The quests have usually been unsuccessful, due to the fact that these animals are seldom caught by the employment of ordinary strategy. Usually they are more clever than the most careful of stalkers.

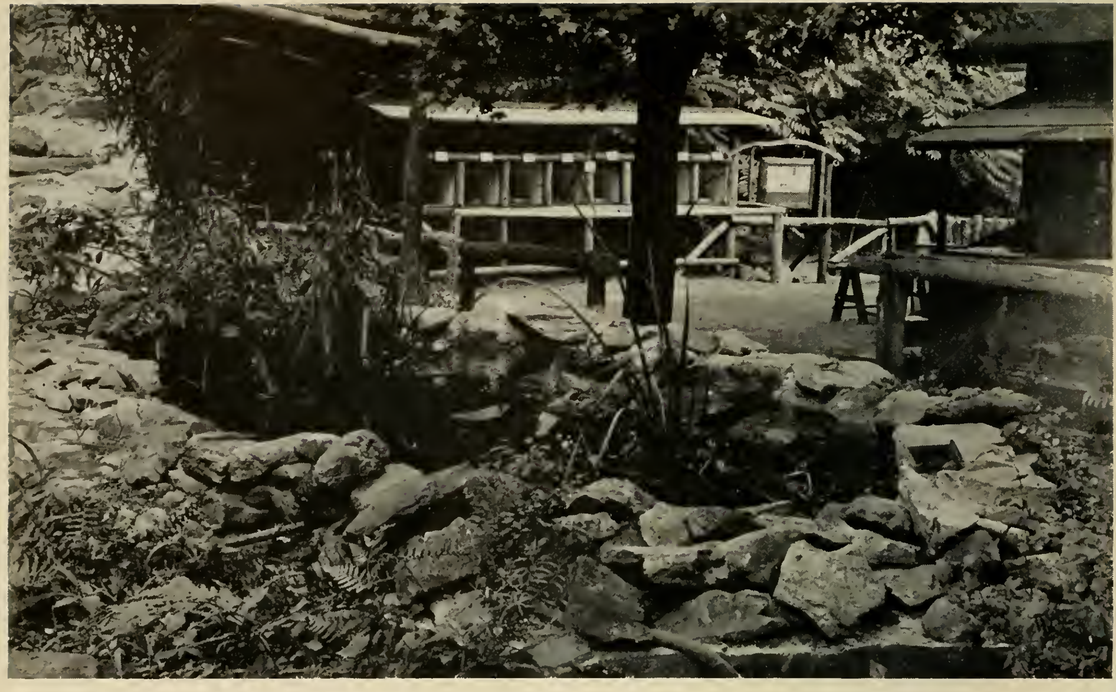
As a direct result of the interest shown by the public in our natural pool, we conceived the idea of building several artificial ones. It soon became apparent that the earth surrounding the small pool would be trampled to such an extent that all the near-by plants would be ruined. We also discovered that fish, and other animals too, could not be properly seen by the average guest. Aquariums in the Trailside Museum served their purpose very well; nevertheless it was our endeavor to present the animals under conditions as nearly natural as possible.

Have you ever built a fish pool on a rock? We thought that the procedure would be a simple one. A beautiful sloping ledge of granite was chosen, cleared of sod, and the work commenced. Flat stones were selected and an excellent stone mason, with several helpers, built a stone wall completely around the rock. A water pipe was inserted at one end and the outlet and overflow were built at the other. The entire structure was simply a ring of concreted stones placed upon a rock.

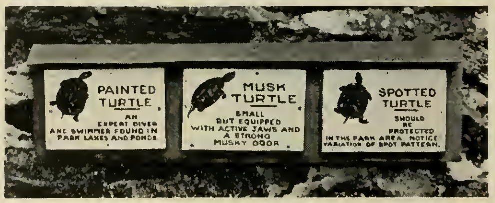
Photograph by M. C. Dickerson

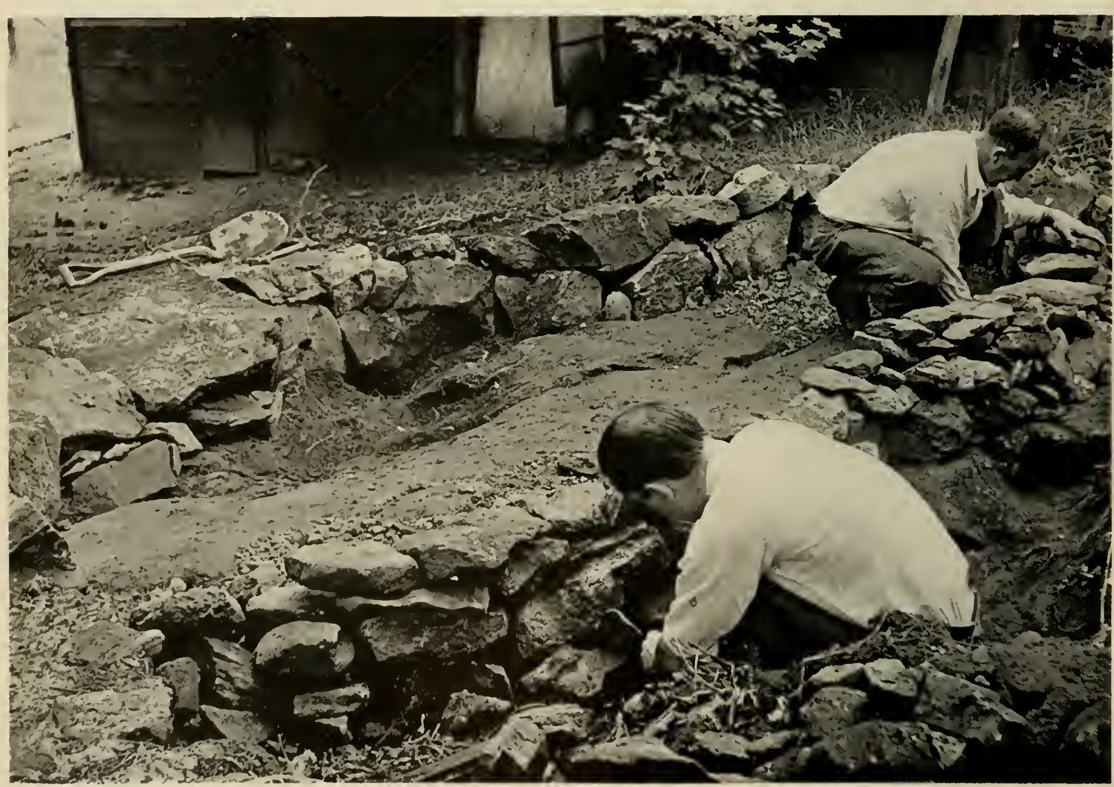
April
Morning

Of all the trees surrounding the pools in the vicinity of Bear Mountain, the slender, graceful, gray birches are the most attractive



The "ring of rock" that forms one of the Trailside pools is pictured above, and below is shown in the making. A typical series of "talking" labels is illustrated at the right. Photographs by Thane Bierwert


PAINTED TURTLE
AN EXPERT DIVER AND SWIMMER FOUND IN PARK LAKES AND PONDS
MUSK TURTLE
SMALL BUT EQUIPPED WITH ACTIVE JAWS AND A STRONG MUSKY ODOR
SPOTTED TURTLE
SHOULD BE PROTECTED IN THE PARK AREA. NOTICE VARIATION OF SPOT PATTERN.



Once the cement had hardened, we hopefully turned on the water and awaited the result. Our minds, envisioning the future, pictured many fish swimming about, many carefully selected plants sprouting, with here a group of cat-tails and there a blue expanse of water, with lily pads floating upon the rippling surface.

Slowly the pool filled. All seemed well until the water approached the top of the surrounding stones; then with a rush, the water commenced to bubble up from the ground before the open door of our Craftshouse, some thirty paces below. There was a leak somewhere and no question about it! The exact location of the break was another matter. Quickly the outlet was opened and the pool drained. A previous search had failed to reveal any telltale bubbles that might have given some indication as to location of the source of trouble.

To make a very long story short, it suffices to say, that after many hours of patient search, and after many experimental plasterings with additional cement, the pool was again filled. This entire process was repeated three times before success attended our efforts.

Then began the search alike for fish and plants. The game warden soon brought in a milk-can filled with minnows and small catfish. Major William A. Welch presented us with a number of fine bass and our pool was stocked. Numerous journeys to neighboring ponds resulted in collections of pickerel-weed and other plants, and our new fish exhibit was in full operation.

In our efforts to confine turtles in a manner advantageous to the public, we had, at an earlier date, built several shallow pools fronting on a tall stone wall. Overhanging flat rocks ringed the water surface and prevented the escape of the hard-shelled inmates. We soon discovered that here was an instance of too much accessibility. One by one the turtles commenced to disappear. The colorful painted turtles (especially the smaller ones) no doubt found their way into several home terrariums. As a result we planted a strip of wild flowers between the path and the pool, thereby discouraging persons who were prone to "collect."

While ours was a "share your knowledge" undertaking, it was not necessarily a matter of "share your exhibits," too!

We have long since learned that it is impossible to please all of our visitors. Our only hope of approaching the millennium in this regard, is to present an exceedingly large number of exhibit types. Often we duplicate the objects used. Our principal purpose is to vary the methods of presentation.

Some persons prefer their turtles in the large natural pool, others in the small observation pool, still others in their hands, and last, but by no means in negligible numbers, there are many visitors who do not care for turtles anywhere or in anyway!

"TALKING LABELS"

Our "talking labels" are frequently the key point in our efforts to arouse interest in our exhibits. We find that visiting naturalists may consider the phrasing too obvious or too complex. Teachers, particularly those recently graduated, sometimes object to our "pedagogy." These latter ones, in their somewhat self-satisfied criticisms, are apt to use such terms as "vitalization, motivation, activation, and methodology," in connection with the wording of our labels. We find, invariably that the more experienced and learned the teacher, the simpler are the terms employed.

Inasmuch as the success or failure of a large measure of our effort depends upon the content of our guiding signs, we are intensely concerned with every expressed viewpoint of school officials. Leaders of education who depend upon knowledge, personality, and years of intimate contact with those whom they instruct are the ones who understand our problems and who offer useful advice.

There is much for us to learn in regard to label writing. When all is said and done our best instructors will continue to be the public for whom the labels are prepared.

Our "talking" pool in the woods will cease to "speak" only when our visitors lose interest in frogs, fish, toads and turtles. We have every reason to believe that it will be a permanent institution.

Science in the Field and in the Laboratory

American Museum Activities, Expeditions, Education, Meetings of Societies, and New Members

Edited by A. KATHERINE BERGER

Templeton Crocker Expedition

Having completed his studies of Polynesian peoples, Dr. Harry L. Shapiro has returned from the Templeton Crocker Polynesian Expedition. The other members of the party, which include Mr. Templeton Crocker, Dr. James P. Chapin, and Mr. F. L. Jaques, are continuing their work in the Chinchas and the Galapagos. They are expecting to return sometime in April.

Doctor Shapiro carried on his researches in the Marquesas, Tuamotos, and the Society Islands, Austral Islands, Rapa, Mangareva, Pitcairn, and Easter Island. At Pitcairn, Doctor Shapiro was able to continue his investigations of the descendants of the mutineers of the "Bounty." All the inhabitants of the island were examined. At Easter, a series of measurements on the living population was obtained, as well as a splendid collection of skeletons and a cast of one of the monolithic stone images unique to that island.

From time to time Doctor Shapiro will communicate interesting aspects of the expedition to the readers of NATURAL HISTORY.

Sage West China Expedition

With the collection of the animals and accessories for the takin group and the giant panda group for the North Asiatic Hall in the American Museum, this expedition has now been brought to a successful conclusion. Other results of the expedition are 2700 natural history specimens, including mammals, birds, reptiles, and batrachians, for the Museum's general collections. This material is en route to New York, and its arrival is expected within the next few weeks.

Fossils from Snow Hill Island, Antarctica

The collection of fossils which Mr. Lincoln Ellsworth gathered from Snow Hill Island in the Wedell Sea area of Antarctica, while his expedition waited during last December and January for favorable flying weather, arrived at the American Museum on March 1, 1935. The seven cases of specimens were immediately unpacked and laid out for review and identification. The collection is a noteworthy one and is exceeded in size only by that made by the Nordenskjöld Expedition of 1902–1903, which spent two seasons in the same region.

The fossils are Cretaceous in age. Various kinds of ancient life are represented, such as fossil wood, corals, sea urchins, pelecypods, gastropods, cephalopods and crustacea. Most of the fossils occur in concretionary masses of a fine-grained sandstone. Frost action has been responsible in most cases for breaking these concretions open along the contour of the included fossil. Counterparts of the concretionary mass and the enclosed fossil are thus common. The effects of weathering and exfoliation are also apparent on some specimens.

Of the fourteen specimens of fossil wood, ten of them show that the fiber was pierced by the boring mollusc *Teredo*, prior to entombment. The wood has been identified as *Dadoxylon* (*Araucaria*) *pseudoparenchymatosum* Gotham, which is closely related to the living *Araucaria imbricata*, the lofty evergreen conifers, native of South America and Australia. The presence of the holes made by the *Teredo* indicates that the wood had reached the sea before the *Teredos* worked upon it. Three of the other specimens of this fossil wood are carbonized and one silicified. They do not show the *Teredo* markings.

While the wood came from the land, all of the other fossils in the collection indicate a marine habitat. The corals are represented by two species: *Cycloseris antarctica*, and *C. larseni;* the sea urchins by one species: *Schizaster antarctica.* There are eight species of pelecypods: *Pinna anderssoni*, *Malletia penacoides*, *Trigonia antarctica*, *Thyasira townsendi*, *Trigonia regina*, *Lahillia luisa*, *Cuculleaea grahamensis* and *Cytherea antarctica.* There is also the cast of the interior of a large clamlike shell which has not yet been identified.

The gastropods are present in considerable numbers, *Perissoptera nordenskjöldi* being the most common. Other species are *Tubulostium fallax*, *Pleurotomaria larseniana*, *Cassidaria mirabilis*, *Cryptorhytis philippina*, *Eunacticina artowskiana* and *Amberleya spinigira.*

The ammonites are well represented. There are ten specimens of the large partly uncoiled *Anisoceras notabile* and many specimens of *Kossmaticeras antarcticum*, some of *K. bahavani*, *K. anderssoni* and one of *Gunnarites antarcticum nordenskjöldi.*

There is one unidentified form of a marine crayfish present with chela and abdominal section embedded in a concretion.

The flora and fauna of this Snow Hill Island collection indicate a warm temperate to sub-tropical climate in late Cretaceous (Senonian) time. The conditions then were markedly different from those of today. Snow Hill Island with latitude 64° 22′ S. now bears a small ice cap. It lies a few miles to the east of Graham Land, that ice-covered point of land some 500–600 miles south of Cape Horn, which more recently has been discovered to be an archipelago connected with the Antarctic continent.

— Chester A. Reeds.

Progress of the Hayden Planetarium

Rapid progress is being made on the new Hayden Planetarium. It seems probable, however, that the building will not be opened to the public until late in the summer. The outer copper dome is almost finished, as is more than half of the inner dome, which is composed of perforated plates of stainless steel. It is on this inner dome that the artificial sky is projected.

Amateur Astronomers Association

In April the Amateur Astronomers Association will hold its two regular monthly meetings. On Wednesday, April 3, at 8:15 P.M., Dr. E. E. Free will give the last in a series of three talks on "Astronomy and Astrology." The subject of this last talk will be "Is Astrology Still Useful? The Real Relations of Planets and Birth Dates to Health, Success and Happiness." On Wednesday, April 17, Dr. Palmer H. Graham of New York University, will talk on "Comets." Anyone interested is invited to attend these meetings. They are held in the auditorium of the American Museum.

During the month of April Miss Marian Lockwood and Mr. Arthur Draper, both of the department of astronomy at the American Museum, will give a series of five dialogues over Station WOR, on Tuesday afternoons from 3:30 to 3:45. The schedule is as follows: April 2 — "Life on the Planets"; April 9 — "Backward Glimpses in Astronomy"; April 16 — "Is Our Universe Exploding?"; April 23 — "Telling Time Yesterday"; April 30 — "The Atom: A Miniature Solar System."

Astronomical Gleanings

The "new" star in Hercules, Nova Herculis, which has created such a furor during the last three months, has subsided, at last reports, to a magnitude of about 3.8. At one time it reached first magnitude, and since there is a difference of 2.5 times between any two successive magnitudes, it is obviously now somewhat less than ⅛ as bright as it was at maximum. . . . An interesting group of sunspots, the largest in many years, was reported in February from German observatories. This group is still visible, and in March members of the department of astronomy counted three good-sized spots in one group. The spots were considerably elongated since they were near the limb, about to pass around to the other side of the sun. This particular group will again be visible approximately the last week in March and the first in April, — that is, of course, if it lasts until the sun's rotation brings the group around again. . . . 1940 is the year now set for the completion and installation of the 200-inch telescope of the California Institute of Technology. This great instrument will be installed on Mt. Palomar, near San Diego.

Planet Notes for April

Venus is the evening star during April, in the constellation Aries until about April 12, and then passing into Taurus, setting on the western horizon about two hours after the sun on April 1, and on April 30 about two and a half hours after sunset. Mars, the ruddy planet, is a beautiful late-evening object in the constellation Virgo, which rises on the first of April about the time of sunset, and reaches the meridian about midnight. Mars will be seen near Alpha Virginis, the brilliant Spica. Jupiter is also easily visible during April in the constellation Libra, the Scales, which at midnight on April 1 is about halfway from the eastern horizon to the meridian.

Phases of the Moon During April

April 3, New Moon; April 10, First Quarter; April 18, Full Moon; April 26, Last Quarter.

Children's Science Fair

The seventh Children's Science Fair, under the auspices of the American Institute in coöperation with the American Museum of Natural History, will open in Education Hall on April 7 and continue through April 14. More than a thousand exhibits made by students in the New York City schools, from the elementary grades through the senior high schools, will be shown. These exhibits are entered under ten classifications — Stars and the Solar System, Earth Studies, Plant and Animal Life, Biology, Physics, Chemistry, Conservation, Industries, History of Science, and Energy.

Museum Techniques in Teaching

The department of education of the American Museum as a part of its coöperation with the College of the City of New York has initiated a course in teacher training for seniors from the School of Education of the College. A group of seniors has been assigned to the Museum for three weeks of intensive work in observation and practice of Museum techniques in teaching. If this method proves successful the Museum expects to continue it on a large schedule in the next semester. The work is under the immediate supervision of Mrs. Ramsey and Miss Mastin of the education staff.

Cadets Guests of the American Museum

On Saturday afternoon, March 9, about ninety cadets of the Second Class at the United States Military Academy visited the American Museum.

After a brief address on the Museum's activities by Doctor Sherwood, the cadets, under the guidance of members of the educational staff, were taken through several of the exhibition halls and especially enjoyed an inspection of the department of preparation. A visit to the Museum has become an annual feature of the Academy's program.

City Educators Guests of the American Museum

On the evening of February 10th a number of prominent city educators and the curators of the American Museum were the guests of the department of education. After dinner a brief address was made by Doctor Sherwood on the work of the Museum, referring especially to its educational program. Dr. Walter Granger spoke on the exploration phase of Museum work, illustrating his remarks by a motion picture film taken in the Gobi Desert. A tour behind the scenes in the Museum followed.

Adult Education Council Meets

The annual meeting of the New York Adult Education Council was held at the American Museum on the afternoon of March 6. Seminars on "The Consumers' Interest in Adult Education — How Do We Locate It?" and "Teacher Training in Adult Education — A Discussion of Current Experiments" were attended by members of the department of education. The meeting concluded with a dinner presided over by Dr. John H. Finley, president of the Council.

Austrian Art Work Exhibited

Under the auspices of the International School of Art, a colorful exhibit of art work produced by girls from ten to fourteen years of age in the Austrian public schools was on view in Education Hall of the American Museum from March 15 to 24.

Appointment

Mr. Paul B. Mann, associate in education, has been appointed as examiner in zoölogy and biology for the College Entrance Examination Board for the year 1935. This is the nineteenth similar annual appointment to this committee work on which Mr. Mann represents the secondary schools of the United States. Mr. Mann was one of the seven delegates from the United States to the First International Congress on Educational Cinematography held last April at Rome, Italy.

Nature Education for Children

For the past few months the department of education of the American Museum has been assisting in a special form of nature education carried on as the Inwood Hill Project by a group of CWA teachers under the direction of Doctor Chatfield of the New York City schools. In good weather classes of children from the public schools are taken to Inwood Park, where they study nature at first hand, also some of the geography and early history of New York. Whenever the weather is unpropitious in the morning, the children come to the Museum. Here members of the educational staff give illustrated talks on "The Indians of Manhattan Island," "The Trees of Inwood Park," and "Local Birds." The children are then taken in groups to study these exhibits in the Museum halls.

Bird Walks

On Tuesday, April 23, Mrs. Gladys Gordon Fry, known to bird lovers and students as "The Bird Lady," will open her spring series of bird and tree walks in Central Park, under the auspices of the American Museum of Natural History.

Central Park is one of the best places in the country to study migratory birds, and New Yorkers have an opportunity that many suburbanites do not enjoy, of observing many different species in a restricted area.

An early morning group will meet at six-thirty o'clock on Tuesdays and Fridays, beginning April 23. There will also be a nine-thirty o'clock group on these days. Each class period will be one and one half hours in length. The fee for the course of ten lessons will be $12.00.

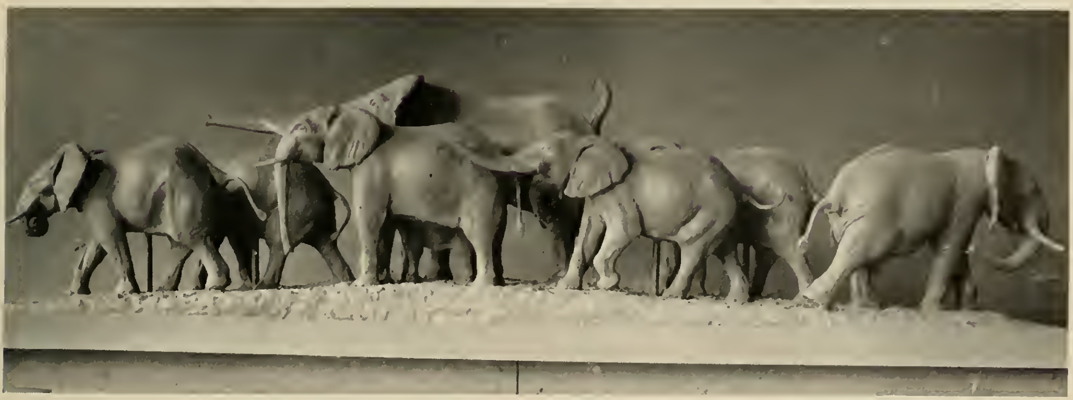
At three-thirty on Tuesdays and Fridays, a children's group will meet. The length of these class periods will be determined by the age of the children registering. The fee for this course of ten bird walks will be $10.00. In addition, a new course for advanced bird students, consisting largely of week-end field trips supplemented by study of Museum specimens, will be offered this spring by Mrs. Fry.

The rendezvous for all groups will be in front of the main entrance to the Museum, on Seventy-seventh Street. Applications may be made to the Department of Education, Room 306, School Service Building, American Museum of Natural History, or by telephoning ENdicott 2-8500, Extension 123.

The Rothschild Collection of Birds

The Rothschild collection of birds is now being unpacked, giving promise of early accessibility to students. It was acquired from Lord Rothschild in London in 1932 and was presented to the American Museum in memory of Harry Payne Whitney by his family, but was never unpacked because of inadequate facilities for storage and display. The collection, undoubtedly the most important and the largest private one in the world, contains about 280,000 specimens, including 55,000 birds of North and South America and 25,000 sea birds.

The collection contains many genera not, up to the present, represented in the American Museum; it gives also a relative wealth of species, known heretofore only from unique specimens. Aside from the rarities, historic specimens, and birds of gorgeous plumage, the greatest resources that the Rothschild



A sketch model of the African elephant group which is to dominate the Akeley African Hall of the American Museum

collection offers to ornithology in America lie in the series of entire Old World families and lesser groups, which, by comparison with American groups, impart new meaning to the subjects of evolution and geographical distribution. It is also invaluable from a taxonomic standpoint.

Following the disposal of the Rothschild collection, the general study collections of birds will be moved to the new wing, and when this is completed, the department hopes to take possession of the offices and laboratories which are now being equipped for use.

A detailed account of this collection and the operation of transferring it from Tring to New York was given by Dr. Robert Cushman Murphy in NATURAL HISTORY for November-December, 1932.

Elephant Group in African Hall

Through the generosity of F. Trubee Davison, president of the American Museum, the four African elephants, collected by him and Mrs. Davison in 1933, are at last being mounted. The better part of a year has been devoted to the task of shaving and bark-tanning the skins preparatory to their mounting. As a preliminary to the tanning, the skins had to be reduced in thickness from their original inch and a quarter to a thin quarter of an inch, in order to make possible not only the easier handling of the skins, but their adjustment to the mount in natural and lifelike manner. The wrinkles and folds of an elephant's hide are strongly individual, very much as are the thumb prints of the human being, and it is therefore essential to prepare the skin so that it may be made to fit the mount as in real life.

The task of shaving these four huge skins consumed several months' time, with four men constantly at work with their fleshing knives, in order to complete the thinning over a combined area of some four hundred square feet of pachyderm.

After the shaving, the process of bark-tanning kept the still weighty skins soaking in a series of vats, with constant turnings and testings to insure thorough and even tanning and the flexible condition of the skins at the end of the treatment.

Now, under the direction of Dr. James L. Clark, Mr. Rockwell is building the life-size armatures preparatory to their receiving the sculptor's clay, and the fifth floor preparation studios are humming with activity.

In the meantime cardboard cut-outs are being added to Akeley's original group in African Hall to determine the poses and positions of each specimen, which will insure the most practical and artistic arrangement of these big pachyderms.

Jamaica Coral Reefs

Mr. Roswell Miller recently left for a trip to Jamaica to make submarine studies of the coral reefs there. He is planning to take under-sea still and motion pictures, including some in Kodacolor.

Stalk-eyed Fishes

A small, but scientifically very important, exhibit is now open to the public in the Deep Sea Room of the Hall of Fishes at the American Museum. This consists of one of the series of growth stages by which Dr. William Beebe has shown that the stalk-eyed fish, formerly known as *Stylophthalmus* is really the young of a very different-looking fish, with normal eyes — *Idiacanthus.*

Stalked eyes are not uncommon among invertebrates, and are occasionally found in other groups of fish. These specimens show the stalk-eyed stage, and one of the later stages in which the eye stalks are shortening up. The eyes are finally drawn back into sockets in the skull, in the normal position.

The males of this species, *Idiacanthus fasciola*, are only about 38 mm. long, whereas the females are about 267 mm. long. The males have a reduced, functionless digestive tract, and no teeth; the females have a carnivorous digestive tract and large teeth.

The larval fishes were taken off Bermuda at a depth of 100 fathoms; the adults between 500 and 1000 fathoms. The specimens are the gift of Doctor Beebe.

Pacific Flying Fishes

A fine collection of Pacific flying fishes, with a few fishes of other kinds, has been received via Valparaiso from the Templeton Crocker Expedition, and will be studied by Mr. Nichols, and by Mr. C. M. Breder, Jr. of the New York Aquarium, research associate in the department of ichthyology, of the American Museum.

Silversides

In 1923 Meek and Hildebrand described from Panama as *Mugilops cyanellus* a small fish belonging to a unique new genus of silversides. Most fishes of this family, like the one commonly used hereabouts for bait, have a bright silver stripe along the side, but *Mugilops* superficially resembles a mullet. It is very interesting to find this species represented in some miscellaneous small fishes collected in 1925 by Dr. R. C. Murphy along the South American Coast from La Plata Island and Santa Elena, Ecuador, to Talara, Peru, establishing a South American record for it.

From the other species in this collection we judge that the tropical Central American shore-fishes occur with little change along the South American coast north of Pta. Pariñas and that the characteristic Southern Hemisphere forms which make the Peruvian shore fauna distinctive occur south of that point. It is possible, however, that unusual warm weather and heavy rains which made 1925 a notable year on the west coast of South America temporarily affected the marine life of Ecuador and northern Peru. — J. T. N.

The Annual James Arthur Lecture

The James Arthur Lecture for 1935 will be given at the American Museum of Natural History, Thursday, April 25, at 8:15 P.M., on the subject of "Structural principles in the nervous system; the development of the forebrain in animals and prehistoric human races."

Following the custom established in past years, the Annual James Arthur Lecture on the Evolution of the Human Brain will be given by an internationally famous authority in the field of neurology, Prof. C. U. Ariëns Kappers, head of the department of neuro-anatomy in the University of Amsterdam. Professor Kappers discovered and developed the principle of neurobiotaxis, which is an important clue to the labyrinth of the central nervous system in vertebrates and gives us many answers as to the *how* and *why* of its intricate patterns. In addition to many technical works on the subject, Professor Kappers is the author of an illuminating treatise on "The Evolution of the Nervous System in Invertebrates, Vertebrates and Man," which presents this most abstruse of subjects in a form comprehensible to the lay reader.

Professor Kappers is also an outstanding authority on anthropology, especially the anthropology of the races of the Near East, where he spent several years in the American University of Beirut, Syria.

The James Arthur Lectureship is provided under the terms of the generous bequest to the American Museum of Natural History made by the late James Arthur of New Rochelle, New York. The lectures already given under this foundation are as follows: "The Brain in Relation to Behavior" by Prof. Frederick Tilney of the Institute of Neurology, Columbia University; "Brains as Instruments of Biological Values" by Prof. C. Judson Herrick of the University of Chicago; "The Story of Fossil Brains from Fish to Man," by Prof. D. M. S. Watson of University College, London.

Professor Kappers has also been invited to deliver the 34th Mary Scott Newbold Lecture of the College of Physicians, Philadelphia, and will give several other lectures in various cities of the East and the Middle West during his short stay in this country.

Early Migration of Man to America

An interesting archæological discovery having direct bearing on the early cultural relations between Asia and America has recently been brought to the attention of the American Museum. The find was made by President C. E. Bunnell and his associates of the Alaska Agricultural College and School of Mines at Fairbanks, Alaska, and resulted from digging a posthole on the campus in the fall of 1933. In July, 1934, Mr. Jack Dorsch, one of Mr. Childs Frick's fossil collectors, now at the Museum, under Doctor Bunnell's direction dug a trench across the site and screened out about 400 mostly fragmentary artifacts, which reached Mr. Frick's paleontological laboratory last November. On examination by the writer, the collection proved to contain, besides hammerstones, chipped projectile points, and numerous reject flakes, about twenty small semi-conical flint cores and several small endscrapers. These last mentioned items, the cores and the small endscrapers, are of special interest because they are identical in several respects with thousands of specimens found in the Gobi desert by the Central Asiatic Expedition in 1925–28. The specimens furnish the first clear archæological evidence we have of early migration to the American continent, apparently during the final or Azilian-Tardenoisian stage of the Paleolithic culture horizon, possibly 7000–10,000 B.C. — N. C. N.

Exhibition by American Museum Artists

The fourth annual exhibition of the work of the Staff Artists of the American Museum will open in the Maxwell Hall of Education April 22 and will continue until May 20.

Many members and visitors to the Museum scarcely realize the scope and variety of this somewhat unique art exhibition. One feature is the combination of scientific exactitude with the utmost in artistic appeal that can be achieved in any field of knowledge which the Museum covers; the other is the versatility of the individual artists in fields outside of the Museum's realm. Last year approximately five hundred examples of their work were shown — oil paintings, including portraiture, landscape, still life; sculpture; pen and ink, pencil and wash drawings; crayon, pastel; leather work, wood carving, pottery, glass blowing, artificial flowers, decorative tile, etc. The subject matter for this year promises a refreshing variation from the usual art exhibition.

The Britton Herbarium

The Britton Herbarium, just designated as the name of collections of reference material at the New York Botanical Garden, ranks as one of the world's most important collections of dried plants assembled for study. In the United States only the National Herbarium in Washington exceeds it in size, and even the flora of Asia is so well represented here that scientists come every year from across the Pacific to study the plants of their own country in New York.

The entire herbarium at the New York Botanical Garden now contains 1,774,687 specimens, of which 70,170 — the largest number in any one year of the institution's history — were mounted and added during 1934. The work of mounting was done by a corps of women, now long trained in this task, from the Emergency Relief Bureau.

More than a quarter million of the specimens are fungi, while 173,000 are mosses, 59,000 hepatics or liverworts, 77,000 algae, and 30,000 lichens. The enormous task of counting the herbarium sheets was completed by Emergency Relief workers last year. Accessions are now recorded each year so that from now on, there will be an accurate record of the size of the herbarium. Few institutions maintain such complete records.

But still more important is the convenient system of reference which is being installed — a system which saves many hours of work each day for the scientists and students using the herbarium.

Nowhere else in the world, so far as known, is such a system in effect.

The Record Proboscidean Tusk

In the January number of NATURAL HISTORY, page 84, are given preliminary estimates of the size and weight of the giant tusk of *Archidiskodon imperator*, presented to the American Museum by a life member, Mr. George D. Doughty, of Post, Texas. As these matters of record size are of great interest to naturalists throughout the world, we may give the comparative figures of more recent estimates by Curator Harold E. Anthony and by Vice-Director James L. Clark:

	Circumference	*Length*	*Weight (est.)*
Record live tusk, African elephant, South Kensington, (Rowland Ward)	24½″	10′ 2½″	226½ lbs.
Record fossil Tusk of *Archidiskodon imperator* (Estimate of James L. Clark) . .	25″	15′ 4″	339¾ lbs.
(Estimate of Harold E. Anthony)	25½″	15′ 4″	400 lbs.

Doctor Clark writes: "You will see that the circumferences are approximately the same [the South Kensington and *A. imperator* specimen] and that the length of the fossil tusk is approximately fifty per cent over that of the live record tusk. Therefore, if we add fifty per cent to the weight of the record tusk, which is 226½, we arrive at a figure of 339¾ for the fossil tusk."

Doctor Anthony writes: "The fossil tusk is an inch and a quarter greater in circumference [than the South Kensington specimen] . . .We have left on the fossil tusk, then, a section at the base 5′ 1½″ long, or a piece about half the length of the piece we have just estimated. This butt section [within the maxilla] certainly would weigh more than half of this estimated piece, because it is approximately 25″ in circumference throughout its entire extent. I imagine it might weigh at least two-thirds as much as the estimated section, or 160 pounds in round figures. The combined weight of the two sections would be 400 pounds, say. I consider that this is a conservative estimate and perhaps another 25 or 50 pounds might be added for good measure."

This giant tusk is being made the basis of a new reconstruction of the *Archidiskodon imperator* of Texas by Margret Flinsch which will give a shoulder height of 13 feet, 6 inches as compared with the maximum height at the shoulder of the African elephant of 11 feet, 6½ inches.

Distinguished Guests

After completing work in the laboratory of Sir Grafton Elliot Smith, Mr. George Pinkley, James Arthur Research Assistant, accompanied by Mrs. Pinkley, sailed for Hong Kong on the twenty-sixth of January. While in Hong Kong, Mr. Pinkley will continue his investigations on the relation between skull-form and brain-form, in the laboratory of Prof. Joseph L. Shellshear of the Medical School of the University of Hong Kong.

Recent American Museum Publications

AMERICAN MUSEUM NOVITIATES

No. 776. African Muscidae. II. By C. H. Curran.
No. 777. *Bairdoppilata*, a New Genus of Ostracoda, with two New Species. By H. N. Coryell, C. H. Sample and P. H. Jennings.
No. 778. A Photograph and Description of *Masturus lanceolatus* taken at Tahiti, May, 1930. The Sixteenth Adult Specimen on Record. By E. W. Gudger.
No. 779. Some Sponges of Lower California (Mexico). By M. W. de Laubenfels.

No. 780. Notes on South American Mammalia. No. 1. *Sciurillus*. By H. E. Anthony and G. H. H. Tate.

No. 781. Two New Species of *Gymnotus*. By F. R. LaMonte.

No. 782. A Note on the Cynodont, *Glochinodontoides gracilis* Haughton. By Lieuwe D. Boonstra.

No. 783. Bees of the Genus *Megachile* from the Belgian Congo. By T. D. A. Cockerell.

BULLETINS

Volume LXVII Article 9. — Catalogue of Mineral Pseudomorphs in The American Museum of Natural History. By Clifford Frondel.

Volume LXVIII Article 3. — Rodents of the Genera *Rattus* and *Mus* from the Pacific Islands, Collected by the Whitney South Sea Expedition, with a Discussion of the Origin and Races of the Pacific Island Rat. By G. H. H. Tate.

Recently Elected Members of the American Museum

Since the last issue of Natural History, the following persons have been elected members of the American Museum:

Associate Members

Mesdames Anna H. Ahrens, Genevieve Bell Airey, Lisa Allen, Gretchen Finch Bayle, Fannie Browdy, Helen M. Cumming, Charles O. Fiertz, F. W. Freeman, Miriam Friedman, Effie Mead Gordon, Francis A. Grubb, John D. Haney, Anna S. Harkavy, Samuel M. Jarvis, Frederick A. Koebel, E. L. Kunkle, John Lindsley, Robert Livingston, Louise Machmer Long, Ethel R. Lott, Henry L. Mischlich, C. M. Neale, Richard M. Pearce, Alice Spencer Rich, Florence F. Rickers, Camden C. Rowe, Sophia S. Smith, Arthur L. Stone, Henry B. Twombly, Fred Wells.

Misses Louise Allyn, Doris LaSalle Baker, Sarah Bernhard, Adele Birnbaum, Alice B. Bobrow, Harriette Britton Brogdon, May F. Buckley, Georgella W. Burr, Charlotte A. Carver, Evelyn Connolly, Elizabeth Culver, Rhea Curtis, Helen Custer, Viola M. Dake, Ethelyn Davison, Lena Lawrence Day, Sara E. Dresser, Jeanne Dreyfus, Phebe L. DuBois, Mary H. Draper, Theresa M. Ebneth, Myrtle Eckhardt, Hilda A. Erbeck, Rebecca Ettenberg, Miriam I. Exiner, Ruth T. Fitzell, Rose Haibloom, Florence S. Hammond, Kathryn E. Harlacher, Letitia Jane Hemenway, Cora Hillyer, Frances I. Hochberg, Esther A. Jacobs, T. Margaret Jamer, Anna M. Johnson, Reba Johnson, Irene B. Karrmann, Mary G. Kilvert, Wilhelmina J. L. Klees, Christina M. Koehler, Mabel E. Kronvall, Adele R. Levy, M. M. Lynch, Monica T. Mansfield, Mary Jane Mason, Isabel McDonald, Madeline Meeker, Fannie L. Moore, Mary E. Moore, Elizabeth M. Moran, Matilda A. Moritz, Mary Mouat, Laura Nallin, Hazel B. Neer, Emily Newton, Margrethe L. Nielsen, Annie R. Nugent, Bertha G. Papen, E. Jean Partridge, Mabel E. Piercy, Carol Louise Potter, Ethel Powers, Irenita M. Powers, Clara A. Priest, Edna R. Provost, Dorothy L. Ralph, Celia Rauch, Marigold A. Reilly, Christina L. Roe, Christine E. Ruppert, Ruth J. Schlockow, Hazel D. Smith, Marion H. Stanwood, Josephine F. Stapleton, Hattie M. Strelitz, Rosetta Newman Treitel, Anne Arrington Tyson, Sarah F. C. Yates, Elsie K. Zimmerman.

Reverends Charles C. Fishburne, Jr., J. Nunan, D.D.

Doctors John Howard Acheson, Stanton Tice Allison, J. Burns Amberson, Francis W. Anderson, John T. Anderson, Sol Axelrad, Robert H. Baker, Ralph S. Banay, Richard T. Bang, Curtis J. Becker, George L. Becker, Kenneth L. Benfer, Axel P. Bergman, Abraham A. Bernhardt, Richard Binion, Abraham Block, Louis Borre, Frank Bostove, Walter E. Bostwick, Prosper J. Boudart, Frederick D. Branch, Lester Breidenbach, Howard W. Brown, Gustav Bucky, Walter Ives Budington, Fred R. Bueche, Raymond Burns, Hector David Castro, George Edward Clark, T. A. Clay, Moses Cohen, Julius H. Comroe, Anthony J. Conty, George F. Dalton, A. F. Dempewolff, Albert J. Devlin, Paul Dozier, Warren L. Duffield, M. Milton Eckert, Adolph W. Eckstein, James P. Erskine John R. Farrell, Attilio Favorini, Jack Fein, Morris Fellman, Joseph Felton, Nathan Fialko, Isaiah Frank, Frank Harrison McGregor, I. Harold Franklin, Leopold Freiberger, Meyer H. Freund, E. D. Friedman, Joseph Fuchs, J. James Ganders, William A. Gardner, Vaughan C. Garner, C. N. Gelber, Wm. T. Godfrey, James Douglas Gold, Charles Goldfarb, Carl Goldmark, J. Ben Goldsmith, Margaret A. Gould, Thomas Norris Graham, Bernard Greenberg, Harry M. Greenwald, Elfriede Phillipi Hesse, Charles H. Holt, George A. Hopp, Lee W. Hughes, David Ide, J. Theodore Irish, Leo Jacobi, Sigurd W. Johnsen, William H. Johnson, Harry Kaiser, Ulysses S. Kann, Joseph Katz, Louisa E. Keasbey, Thomas Benjamin Kern, Robert P. Knapp, John M. Kolb, M. Krimke, Stuart E. Krohn, Thad A. Krolicki, Isidor Kross, Arthur E. Lamb, Michael G. Landa, Harry Landesman, George Levene, Harris J. Levine, Seth A. Lewis, Harold Liggett, Joseph E. Lumbard, George Edward Maurer, John McAllister, H. Stewart McBurney, Floyd W. McRae, Robert A. Mee, H. Victor Mendelsohn, Samuel Monash, Albert W. Moulton, Gerard H. Mueller, J. Ernest Nadler, G. L. Neumann, William Neumann, John L. Nicholaus, James Nightingale, Samuel S. Nussbaum, Alfred T. Osgood, Samuel M. Peck, Ernst H. Pirkner, Harry S. Pizer, Emery M. Porter, Norman Henry Pritchard, J. Edwin Purdy, Wm. A. Randel, Paul Ernest Rauschenbach, S. B. Reich, Leon Reznikoff, Maurice L. Ripps, Hope T. M. Ritter, William T. Robinson, Silvio Amadeo Sabatini, Geysa Sarkany, James R. Scott, F. L. Seymour-Jones, George Robert Shapiro, Philip Shapiro, Nathaniel Sipilesko, David Sloane, Alexander L. Smith, W. Henley Smith, Sidney Sorrin, Mortimer D. Speiser, E. Myles Standish, Walter T. Stenson, John G. Stubenbord, 3d, Philip John Trentzsch, Frederic N. Wilson.

Honorable Julian W. Mack.

Messrs. Phil H. Ahrens, Charles A. Alexander, Samuel J. Algranti, F Curtis Allen, Winthrop Allen, Theo. R. Alpenfels, W. G. Arndt, Robert T. Ash, Maurice Asher, H. V. Atkinson, Frank L. Bailey, George Raily Bailey, Laurance C. Baker, William Pitt Baldwin, L. S. Barkley, Thomas E. Barns, John Forrest Barr, James Barrow, William C. Baur, Geo. E. Benson, Jefferson D. Billmyer, Harry Templeton Birney, R. C. Bittenbender, A. C. Blanchard, Edmund T. Blazewicz, Leopold Blum, Frank Bluntzer, George C. Boorn, David Bornet, George C. Briner, J. D. Brother, H. Emmett Brown, Geo. G. Bulkley, Ralph W. Bull, J. E. Butler, James H. Coberly, Henry Cory, Samuel E. Coxe, Frank L. Crabbs, Elmer E. Daley, William L. Dambach, Charles F. Davis, George H. Dehn, Jr., Nathan De Scherer, E. L. Dickson, Walter H. Diers, Irving Dolganos, Geo. H. Doscher, A. F. Drummond, Albert Earley, Gilbert D. Eaton, Albert E. Eberman, Andrew Edwards, Jr., Chas. O. Edwards, J. M. Edwards, Albert W. Eichenberger, Alfred M. Ellinger, Rodney Ray Ellis, William A. Ellis, Arthur C. Erbstoeszer, William Carson Ervin, James W. Fairchild, James Farber, Leo Feldman, W. F. Fiery, A. Carlton Finter, L. T. Flick, J. W. Foster, Herman W. French, Leonard D. Frescoln, Charles B. Gardiner, Edward Martin Gates, James G. Goblisch, Herbert S. Goodman, Samuel J. Greenberg, Stanley E. Gregg, Edward Bellamy Gresser, Morris Gurin, E. H. Hankerson, C. W. Hanks, Alfred Harris, C. P. Hasse, W. Rowland Hawkins, O. F. Hennings, H. G. Hicks, Roland F. Holloway, Clifford E. Homan, Lyman H. Hooker, Wallace B. House, John C. Howard, Ellsworth Eugene Howe, Robert W. Howes, Frank Leeroy Hubbard, Carl H. Ill, Robert Jackson, Walter Jacobson, Henry Jacoby, J. C. Jeffries, B. A. Johnson, Harold Johnson, Carl A. Kanske, Edward Leland Kellogg, J. B. Kellogg, O. R. Kerley, Sidney J. Kerzberg, Homer D. Klumpp, Alfredo Kniazzeh, W. E. Kohn, Solomon Koral, Charles A. Kramer, William Krampner, John A. Kulier, Louis Kevin Lambert, Francis A. La Porte, Ralph H. Larson, J. Wilbur Lewis, Wm. J. Lewis, Howard Y. Lissenden, H. W. Lloyd, R. L. Lodge, C. E. Loertz, R. A. Longman, William P. Lough, Hugo Lucas, William Howard Lundin, John Luxton, W. C. Lyon, S. L. Magerfield, William N. Malbin, F. S. Malley, Abraham Mandelstam, Milton B. Marks, James C. Martin, Joseph McCoy, Brooks W. McCuen, C. E. McCutchen, Leslie G. McDouall, Rowland R. McElvare, Francis J. McGinnis, James H. McGowan, G. P. McGraw, B. B. McKay, Wheeler McMillen, E. G. McMonigle, Samuel Herbert McVitty, George P. Meade, Frederick Henry Meichner, John Bunker Mendonca, Harold R. Merwarth, John M. Merwin, Harry O. Metzger, Frederick P. Meusch, John L. Milholland, Jr., Frank Q. Millen, Albert F. Miller, David B. Miller, Wm. B. Miller, Charles Mitchell, Ralph E. Mook, John G. Moore, Thomas Wm. Moore, Jr, Walter D. Moore, Jr., Bert Morgan, Frederick N. Morgan, J. I. Morgan, Harry T. Morris, Kenneth M. Morrison, John A. Morse, L. Howard Moss, Henry R. Muller, Barry S. Murphy, D. M. Myers, Jacob W. Myers, Robert F. Nelson, C. N. Newcomb, Harvey Newcomer, H. Sidney Newcomer, William W. Newman, H. L. Niemann, Adolph Niolon, William D. Niper, A. B. Nolan, R. G. O'Connor, Roland M. Odgers, James E. O'Kane, Rex L. Oliver, Frank L. Park, Lloyd Penick, Jos. J. Peryon, L. H. Petit, F. R. Phelps, Armstead David Phillips, Henry Pick, David B. Plum, Lloyd Pollard, J. C. Poole, W. E. Popham, Robert E. Powell, J. H. Powers, Roy Edward Pushee, Horton F. Randall, Charles M. Rash, Roy L. Raymer, Victor P. da Cunha Rego, A. J. Reich, E. V. Richards, Franz R. J. Richter, M. H. N. Ritter, James Robertson, Albert S. Robinson, Nathan A. Rothstein, Rosolino L. Rotolo, J. A. Rutherman, H. G. Safford, Garret Sanderson, Jr., Carl G. Schmidt, Andrew C. Schnack, John Schwarz, V. Bayard Sheeder, Sam G. Smith, G. H. Stahler, J. H. Stanley, H. H. Stecher, Sidney H. Stein, Ethelbert Stewart, Abraham Stolman, Edward Streeter, Charles F. Strenz, Richard H. Traiser, Patrick A. Twomey, Julien W. Vose, Herbert Waller, George A. Way, J. H. M. Wedderburn, Christian N. Wenger, W. C. Wilkins, Jacob Williamson, Adolph F. Wizemann, Edw. R. Ziegler.

Reviews of New Books

Recent Publications for Those Interested in Nature

The Musical Instruments of the Native Races of South Africa. By Percival R. Kirby. Oxford University Press, London, Humphrey Milford, 1934 285 pages, 73 plates (156 illustrations) and music. Published with the assistance of a grant made by the Carnegie Corporation through the Research Grant Board of South Africa. $12.

IN ORDER to procure the material for this magnificent volume, Professor Kirby made nine expeditions covering thousands of miles and several years, into the interior of South Africa. It was his aim in assembling and publishing the data on the great wealth of native musical instruments in this part of the continent, to make the study as complete as possible. There is every indication that he succeeded, not only in procuring the information, but in his explicit, clear, and interesting descriptions, his musical examples, which give not only the tunes played but the manner in which they were produced, and the fine photographs, showing not only details of construction but the manner of manipulating the instruments. No expenditure of time or money has been spared on this volume, which, in its physical make-up is in the best Oxford style, and it will doubtless take its well-deserved place as the standard reference on this subject for all time. The author has arranged that separate sets of the photographic plates may be procured by museums, so that each may be placed beside the appropriate instrument on display, to illustrate its manner of use.

The reviewer has only two "unfulfilled wishes," the first being that in his complicated chapter on Stringed Instruments, with its sub-groups and numerous cross references to instruments and tribes, the author had clarified his treatment, which is straight running text, with a tabulation of sub-groups by number at the beginning of the chapter and a physical division of them by sub-headings as they were taken up in detail. Most of his readers will approach the subject as relative strangers, and be confused by the labyrinth in which Professor Kirby has long been so at home.

Second, while it is unfair to demand a treatment which the author obviously did not intend to go into, in a pure cataloguing and description of instruments, the addition of some maps of distribution of types would have been very valuable. They could be worked out with due regard to time sequence and it is hoped that at some future time this will be done.

Psychologists and students of culture change should find of interest many remarks made in passing, particularly those on pages 164, 246, and 257 to the effect that despite the physical imitation of foreign instruments now going on, "the fashioning of and performance upon indigenous instruments has remained practically uninfluenced by such imitations, which, untrammelled by taboos or ceremonial restrictions, seem always to have stood apart"; and that when performing upon these or even strictly European models like jew's harps, mouth harmonicas, German concertinas, guitars and auto harps, most of which are easily capable of producing diatonic scales and full harmonics and readily played, the pagan native never performs European music on them, but only that designed according to his own principles, deliberately omitting other possibilities. This has even been noted in the borrowing of the idea of reed flute ensembles from the Venda by the Sotho and Ndebele, whose own scale was retained. Moreover, Christian natives, i.e., presumably those born and brought up in a Christian environment, are seldom seen with the types of instruments popular with the pagans.

— Helen H. Roberts, Yale University

The James Johnstone Memorial Volume. Issued from the Lancashire Sea Fisheries Laboratory and published by the University Press of Liverpool, 1934.

THIS is indeed a fitting memorial, summarizing the life and activities of the famous "J. J.," as he was affectionately known to his colleagues. This volume begins with an excellent biographical note by F. J. Cole, professor of zoölogy in the University of Reading, England, and is amplified by reports on a series of original researches relating to marine and fresh-water biology, such a series as would be produced by a fisheries laboratory.

The late James Johnstone was one of the most famous of modern oceanographers, and was foremost among the authorities on fishery research in Europe. As such, he was a self-made scientist, starting out as a poor boy and practically forcing himself through all the preliminary stages of preparation. He was admitted to London University in 1897, and in South Kensington came under the influence of Professor Howes. Later, he succeeded Andrew Scott in the Fisheries Laboratory in Liverpool. He graduated as a Doctor of Science at London University in 1913. He was the author of some ninety papers and books, most of the former appearing in the annual reports of the Lancashire Fisheries Laboratory at Liverpool. In 1920, he was appointed professor of oceanography, and subsequently honorary director of the scientific work of the Lancashire Sea Fisheries Committee.

Among his most useful publications was the *Introduction to Oceanography*, in 1923, of which two editions were published, and his *Study of the Oceans* in 1926. *A Monograph of the Marine Plankton* followed in 1928, and his last work, a textbook, *Essentials of Biology*, was published in 1932, the year of his death.

Aside from his more special researches, he developed a world-wide reputation due to his insight into the principles and methods of oceanography. Naturally a philosopher, his many-sided mind caused him to devote much time to the general problems of biology, and he wrote three books on the subject, namely, the *Philosophy of Biology*, in 1914, and the *Mechanism of Life*, in 1921, as well as the *Essentials of Biology* already mentioned. Space does not permit a discussion of his philosophical views. His organizing ability, his talent for practical matters in connection with fisheries problems, and the philosophic side of his investigations give a comprehensive idea of his versatility.

To give even a brief description of the score of papers brought together in the Memorial Volume to honor this great man would fill many columns. Suffice it to say that his scientific colleagues, friends, and associates joined in contributing from the best of their scientific work to honor his name and to emphasize by their own attainments the eminent circle of scientific thinkers to which he belonged.

— Roy Waldo Miner

The White Headed Eagle: John McLoughlin, Builder of an Empire. By Richard G. Montgomery, 358 pp., Macmillan Company, $3.50.

THIS is a worthwhile account of the Hudson Bay Companies' conquest of the American "Northwest." It is also the story of Chief Factor, Dr. John McLoughlin, who, as dictator of the Oregon and Vancouver territories during the first half of the Eighteen Hundreds, carved the foundations of Empire for Great Britain. Unwittingly "Doctor John" also pioneered for the future territorial expansion of the United States. After a rough life of persevering struggle and hardship in behalf of Canada, McLoughlin ended by becoming a citizen of the United States, spending his last days in the country of his adoption.

The book furnishes us with a condensed picture of the fur trade in the Columbia River region. It tells of heroic overland journeys, of the establishment of far flung trading posts, of colonization and of Indian warfare.

Doctor McLoughlin is presented as a slightly saint-like individual, who ruled with a firm but pious hand. At times it seems a pity that he was not possessed of more vices. One of the relieving scenes showing the Chief Factor in "a most unfavorable light," concerns a hypocritical and officious visiting minister whose activities were more related to politics than to religion. The minister persisted in writing untruthful and slanderous statements relative to the manner of "Doctor John's" conduct of affairs in Fort Vancouver. Doctor McLoughlin's ire was raised to the extent that, on one occasion, "up went his trusty cane" and he "inflicted several sound blows upon the shoulders of the impertinent Divine." One gathers that the stern Doctor had many difficulties with "Divines," for the author has entitled one of his chapters "Too Many Missionaries."

Of far more importance than Doctor McLoughlin's sterling character is the panorama of wilderness exploitation, set forth throughout the book. It was ever an instance of "gold lies where fur is." The welfare of the country as a whole, and the well-being of the men who preyed upon it, was totally lost to view. Every other consideration was put aside until the fur-bearing animals had been reduced to a scant remnant of the original wild life population.

In the fifteen references to the slaughter and use of the all important beaver alone, we discover many revealing tales of trapping experiences and of sharp practices in trading with the Indians. As late as 1842 fur was the medium of all barter. We find a man in need of clothing, but without the necessary wherewithal to secure it. Mr. Montgomery tells us that "Money, had he possessed it, would have served no useful purpose, as furs, at a fixed valuation, constituted the first coin of the realm, and wheat the second."

A careful reading of this book, with frequent reference to the fine bibliography, should serve to provide a good popular approach to a further background study of the history of the states of Oregon and Washington. The work is well indexed and well written.

— W. H. Carr

Homes and Habits of Wild Animals. By Karl Peterson Schmidt. M.A. Donahue & Co.

Homes and Habits of Wild Animals is the title of an attractive book written by Karl Peterson Schmidt and published by M. A. Donahue & Co. Mr. Schmidt is the assistant curator of reptiles at the Field Museum of Natural History in Chicago, but has had extensive field experience and an opportunity to make many observations on the habits of mammals as well as reptiles. Although the book is written in terms simple enough for younger readers, and the presentation is that often followed for juvenile publications, readers of all ages will find these pages interesting and instructive.

Mr. Schmidt, who, many readers of Natural History will recall, was formerly on the staff of the American Museum, has selected his nine chapters to deal with animals, not in a blood relationship, but as animal workers, animal fishermen, animal travelers, et cetera. In these chapters he selects outstanding examples as illustrations, and in a simple, descriptive style holds up the characters for inspection. A liberal use of narrative and anecdote brightens the picture.

The work is illustrated by Walter Alois Weber, with twelve full-page color plates and numerous marginal drawings. Mr. Weber displays a close acquaintance with mammal psychology, and his figures have character and action to a remarkable degree. The only criticism one might make is with regard to the somewhat high coloring of the full-page plates. The tendency of the artist to see purples in the shadows results in a rather high key for these plates. The result is, however, a very pleasing and brilliant picture without any very great violence to fidelity. Furthermore, children will react very favorably to this type of colored illustration.

— H. E. Anthony

Are you interested in the great nations which preceded ours in the Western Hemisphere? If so, you will find

Old Civilizations of Inca Land

By Charles W. Mead

A fascinating story of an ancient people who achieved a high degree of culture in the new world before its discovery by the white man. In the study of their architecture, their social and political organization, their religion and ceremonies, their art and their science, you will find the thrill of real adventure.

117 Pages, 55 Illustrations
Bound in cloth
Price $1.10 postpaid

Address orders to The Librarian
THE AMERICAN MUSEUM OF NATURAL HISTORY
77th Street and Central Park West
New York, N. Y.

All payments must be made in advance

VISITORS & MEMBERS
at the Museum

ARE INVITED TO PATRONIZE THE

RESTAURANT

ON THE SECOND FLOOR OF THE MAIN BUILDING

Operated for the convenience of Members and Visitors

*

LUNCHEON
11:00 to 2:00 o'clock
40 cents; 50 cents; also a la carte

AFTERNOON TEA
2:00 to 4:45 p.m.

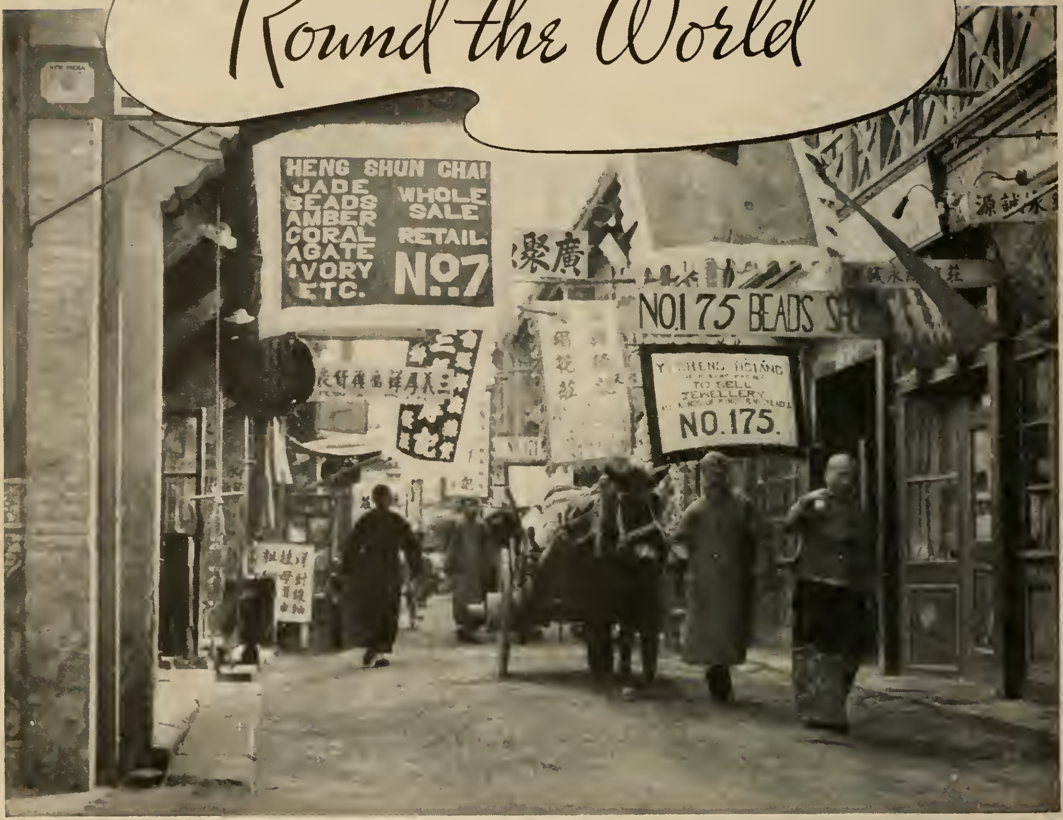
DINNER IS SERVED
on evenings of regular and special Members' Lectures
6:00 to 8:00 p.m.
Price $1.00

*

A VIEW OF THE AMERICAN MUSEUM RESTAURANT

GO THIS SUMMER!

Round the World



In less than three months you can cruise by President Liner to a score of the fascinating places you've dreamed of seeing. Hawaii, and the palm-fringed beach at Waikiki. The fairyland of Japan, with its bright-kimono'd people, its tiny gardens and mighty mountain peaks. The island-studded Inland Sea. Then China, treasure-house of the ages. The friendly, tropical Philippines. Malaya, where Singapore stands at the crossroads of the world. Ceylon . . . and India, with its Taj Mahal that symbolizes the romance of the storied East. Then Egypt, the Sphinx and Pyramids. Italy and France!

FIRST $850 CLASS

A world cruise used to take a lot of time and money. But nowadays, by President Liner, you can make a complete circuit of the globe in as little as 85 days—at a low First Class fare that makes it almost cheaper than staying home.

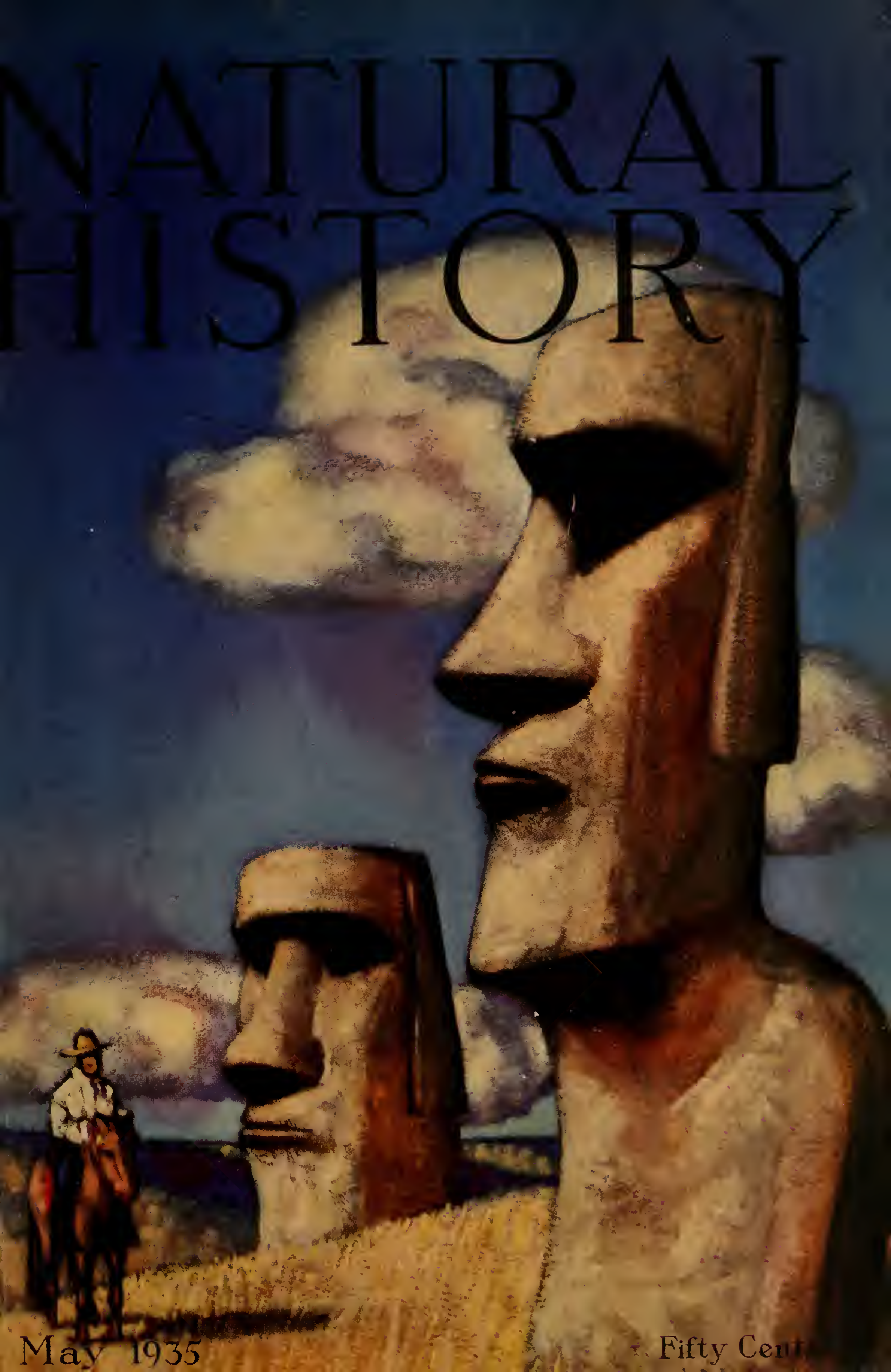
Take your family! For children and others who have summer vacations, this world cruise is particularly ideal. You have ample time for sightseeing in every port. At many places you can leave your ship, take thrilling sidetrips to spots like Kyoto and Nara in Japan, then rejoin the same President Liner and continue on to new ports and new adventures. If you have time you may stopover as you please in any or all ports, taking up to two full years.

President Liners are noted for their delightfully informal shipboard life, and for the interesting people you always find on board. Every stateroom is outside. Every liner has an outdoor swimming pool. There is a sailing every other week from New York and California via Hawaii and the Sunshine Route, and from Seattle via the Short Route.

Let your travel agent help you plan your cruise (his services are free). Ask also about other President Liner trips—between New York and California, and to the Orient and back. Or see any of our offices: 604 Fifth Ave., New York; 110 So. Dearborn St., Chicago; Statler Bldg., Boston; 311 California St., San Francisco; 514 W. Sixth St., Los Angeles; Washington, D. C., Toronto, Cleveland, Seattle, Tacoma, Portland, Oakland, San Diego, Vancouver and Victoria, B. C.

DOLLAR STEAMSHIP LINES
AND AMERICAN MAIL LINE

NATURAL HISTORY



May 1935

Fifty Cent

FIRST CHOICE FOR BIG GAME

WINCHESTER
TRADE MARK

Super Grade MODEL 54

For the Rockies especially, from Old Mexico to the Arctic—but likewise for Newfoundland, the Labrador, the Maritimes, Quebec, Ontario, or deer from Maine to Minnesota—you will find the new Winchester Super Grade Model 54 Rifle supremely satisfactory. There with the limit in handling speed and dependability, superb accuracy, and maximum stopping power according to the cartridge you pick.

.250-3000, .270, or .30/'06

WITH velocities up to 3,000 f.p.s. and over, Model 54 in one of the above calibers gives a truly remarkable range of service. Extensively used for year-'round long range game and target shooting. "Nail-driving" accuracy in .270 Win.; power from woodchuck up to grizzly, according to choice of five cartridges. For general big game hunting, .270 or .30/'06. Furnished with either 24-inch barrel as shown, or 20-inch—convenient for saddle and climbing, faster in thick cover. See the Super Grade Model 54 at your dealer's. Furnished also in .22 Hornet, 7 mm, 7.65 mm or 9 mm. For new Folder, write Dept. 43-C,

WINCHESTER REPEATING ARMS CO., New Haven, Conn.

TREES, FLOWERS
AND INSECTS,
BIRDS, ANIMALS,
REPTILES AND
FISH

HOW NATURE
TRAILS ARE BUILT
AND TRAILSIDE
MUSEUMS
DEVELOPED

BEAR MOUNTAIN TRAILSIDE MUSEUM BUILDING

TRAILSIDE MUSEUM PUBLICATIONS

By WILLIAM H. CARR

The six pamphlets describe the start, continuation and operation, and the human and wild life experiences at the American Museum's Trailside Museum and Nature Trails at Bear Mountain-on-the-Hudson. Many entertaining visitors walk through the pages. Jim the Crow; Coco, the raccoon; and numerous other creatures speak for themselves.

"SIGNS ALONG THE TRAIL" (1927, 29 pages, 20 illustrations) . . . . *price* 10c
"BLAZING NATURE'S TRAIL" (1928, 21 pages, 16 illustrations) . . . . . *price* 15c
"TRAILSIDE CONVERSATIONS" (1929, 36 pages, 27 illustrations) . . . . . *price* 20c
"TRAILSIDE ACTIONS AND REACTIONS" (1930, 32 pages, 27 illustrations) . . *price* 20c
"TRAILSIDE FAMILY" (1931, 34 pages, 28 illustrations and full page map) . . *price* 20c
"TRAILSIDE INTERDEPENDENCE" (1932, 22 pages, 10 illustrations) . . . . *price* 15c

The set of six pamphlets totaling 174 pages and 128 illustrations may be purchased for $1.10 postpaid.

Address orders to

THE LIBRARIAN, THE AMERICAN MUSEUM OF NATURAL HISTORY
77TH STREET AND CENTRAL PARK WEST NEW YORK, N. Y.

All payments must be made in advance. If ordered separately three cents additional postage must be sent for each pamphlet

A Vote for Nature

These three new bills for additional national parks deserve your active support. Write your representative to endorse these measures

Bills providing for the establishment of three new national parks have recently been introduced in Congress. These proposed parks would feature interesting and valuable species of plant and animal life, as well as exceptional scenic grandeur.

* * *

Bill H. R. 7086 introduced by Congressman Monrad C. Wallgren of Washington, provides for the establishment of the *Mt. Olympus National Park* to include the present Mt. Olympus National Monument and some of the surrounding region. To quote from a release of the United States National Park Service:

"The finest remnant of the Pacific-Northwest forest is now confined to a portion of the Olympic Peninsula. Nowhere else in our country is there opportunity now to see and enjoy the bigness of these forests which have gone into the building of our nation. Giant hemlocks, Douglas fir, white fir, Sitka spruce, and red cedar crown the forest two hundred feet above the forest floor. . . . The shaggy robe of forest is broken only where snow-topped peaks break through and rivers cut their swift course down through wooded canyons to the ocean.

"Black bears, bobcats, marten, fisher, mink, and mountain beaver are still present in the forest. Black-tailed deer are seen, and sometimes, cougar tracks along the river trails. This is the last great hereditary range of the Roosevelt elk. Thousands of this species of elk still roam the forest slopes of Mt. Olympus and migrate . . . to the winter range along the streams.

"Because privately owned timber on the Peninsula is nearly exhausted, there is constant clamor for allocation of this last virgin stand. Successive nibblings for timber cutting purposes have reduced the area of the monument to approximately half of its original size. The monument does not now contain the finest of the forest nor winter range for elk. A national park should be created here."

* * *

Bill S. 2289 introduced by Senator Hiram Johnson of California provides for the establishment of *Kings Canyon National Park*, adjacent to Sequoia National Park.

"Ever since the Kings Canyon area was proposed as a national park by John Muir about 1890, it has been opposed by certain local interests in order that the development of power and irrigation resources might be permitted, if and when needed. . . .

"Kings Canyon is world famous scenery; it is a superlative area. Its fate will soon be decided, permanently, irrevocably. Either it will be saved as a national park for the benefit and enjoyment of the people, or it will be given over to commercial development."

* * *

Senator Morris Sheppard and Senator Tom Connolly of Texas introduced Bill S. 2131 to provide for the establishment of the *Big Bend National Park* in Texas.

"The area referred to in these bills is a semi-arid plain, verging on desert, through which a group of mountain ranges has been thrust. . . . Large mammals such as the bear, deer, panther and fox abound.

"The varied forest cover in the Chisos is still virgin, and includes the Douglas fir, pine, juniper, oaks and hackberry. . . . From the south rim of the Chisos can be had a most dramatic view of the American and Mexican terrain for a radius of 200 miles. In the foreground to the south and 5000 feet below flows the Rio Grande River which has cut a tortuous course in the form of the steeped walled canyons. . . .

"Because this section includes many unusual forms of animal, bird and plant life native to Mexico, the Big Bend project forms a unique and necessary link in the perfection of the National Parks system."

There will undoubtedly be some local opposition to the passage of these bills, more especially to the first two. Members of the American Museum of Natural History are urged to write to their Congressmen endorsing the provisions of these bills and to give such other support as may be possible in order to secure in perpetuity these desirable remnants of our former great public domain.

—H. E. Anthony

THE AMERICAN MUSEUM OF NATURAL HISTORY

FOUNDED IN 1869

BOARD OF TRUSTEES

Henry Fairfield Osborn, Honorary President
Frederick Trubee Davison, President

J. P. Morgan, First Vice-President
Cleveland E. Dodge, Second Vice-President
E. Roland Harriman, Treasurer
Clarence L. Hay, Secretary
George F. Baker
George T. Bowdoin
Douglas Burden
Suydam Cutting
Lincoln Ellsworth
Childs Frick
Madison Grant
Chauncey J. Hamlin
Archer M. Huntington
Ogden L. Mills
Junius Spencer Morgan
A. Perry Osborn
Frederick H. Osborn
Daniel E. Pomeroy
H. Rivington Pyne
A. Hamilton Rice
John D. Rockefeller, 3d
Kermit Roosevelt
Henry W. Sage
Leonard C. Sanford
William K. Vanderbilt
Frederick M. Warburg
Cornelius Vanderbilt Whitney

Fiorello H. LaGuardia, Mayor of the City of New York
Frank J. Taylor, Comptroller of the City of New York
Robert Moses, Commissioner of Parks of the City of New York

ADMINISTRATIVE STAFF

George H. Sherwood, Honorary Director
Roy Chapman Andrews, Director
Wayne M. Faunce, Vice-Director and Executive Secretary
James L. Clark, Vice-Director (Preparation and Exhibition)
Frederick H. Smyth, Bursar
Francis Bushell, Assistant Bursar
H. F. Beers, Chief of Construction
George N. Pindar, Registrar
Ethel L. Newman, Assistant Registrar
Henry J. Langham, Chief Engineer
J. B. Foulke, Superintendent of Buildings

Hans Christian Adamson, Assistant to the President

SCIENTIFIC STAFF

Frederick Trubee Davison, LL.D., President
George H. Sherwood, Ed.D., Honorary Director
Roy Chapman Andrews, D.Sc., Director
Wayne M. Faunce, Sc.B., Vice-Director and Executive Secretary
James L. Clark, D.Sc., Vice-Director (Preparation and Exhibition)
Frederick H. Smyth, Bursar
George N. Pindar, Registrar

DEPARTMENTAL STAFFS

Astronomy

Clyde Fisher, Ph.D., LL.D., Curator
Hugh S. Rice, B.S., Associate in Astronomy

Minerals and Gems

Herbert P. Whitlock, C.E., Curator

Fossil Vertebrates

Henry Fairfield Osborn, D.Sc., LL.D., Honorary Curator-in-Chief

Childs Frick, B.S., Honorary Curator of Late Tertiary and Quaternary Mammals

Fossil Vertebrates (Cont.)

Walter Granger, D.Sc., Curator of Fossil Mammals
Barnum Brown, Sc.D., Curator of Fossil Reptiles
G. G. Simpson, Ph.D., Associate Curator of Vertebrate Palæontology
Charles C. Mook, Ph.D., Associate Curator of Geology and Palæontology
Edwin H. Colbert, A.M., Assistant Curator
Rachel Husband Nichols, A.M., Staff Assistant
Walter W. Holmes, Field Associate in Palæontology

Geology and Fossil Invertebrates

Chester A. Reeds, Ph.D., Curator

NATURAL HISTORY
May
1935

Natural History is published monthly (except July and August) at 10 Ferry Street, Concord, N. H., by The American Museum of Natural History, New York, N. Y. Subscription price $3 a year, single copies fifty cents. These rates also apply to Canada, Newfoundland, and all foreign countries. Entered as second class matter at the Post Office at Concord, New Hampshire, under the Act of August 24, 1912.

Volume XXXV
No. 5

NATURAL HISTORY

The Journal of the American Museum of Natural History

VOLUME XXXV ★ ★ ★ ★ **MAY 1935**

Stone Monuments on Easter Island . . . . *Cover*

From a Painting by W. L. Kihn

Wild Life in a City Park . . . . *Frontispiece*

A Modern Picture Book Zoo 363

The Reconstructed Zoölogical Garden in the Heart of the Great New York Metropolis

Mystery Island of the Pacific . . . . H. L. Shapiro 365

An Account of an Extraordinary Island and Its Strange Civilization

American Date Gardens . . . . Emmy Matt Rush 378

A Staple Food of the Peoples of the Desert Regions in the Far East Transplanted to the American Southwest

The Petrified Forest . . . . Wendell and Lucie Chapman 382

A Fascinating Display in a Rarely Visited Part of Yellowstone Park

Conservation Expands in Africa . . . . Mary L. Jobe Akeley 394

Carl Akeley's Dream of Absolute Sanctuary for the Vanishing Wild Life of Africa Is Being Realized

Fortune and Misfortune in Antarctica . . . . Lincoln Ellsworth 397

Adventures and Discoveries of the 1934–35 Ellsworth Expedition to Graham Land

Wild Animals of the Hudson Highlands 405

A Pictorial Record of Some of the Mammal Life to be Found Near New York City

5000 Years of Exploration . . . . Harold Ward 411

The Story of World Discoveries as Told in Unrolling the Map

Alligators of Georgia. . . . . Charles Newton Elliott 416

Picturesque Saurians That Carry on a Strange Existence in the Okefenokee Swamp

Insect Giants . . . . C. H. Curran 426

Some Members of the Insect World That Are Interesting Because of Their Huge Size

Nature's Sea Serpent. . . . . William K. Gregory 431

An Authentic Account of the "King of Herrings" and Its Encounters with Homo sapiens

Science in the Field and in the Laboratory 438

Current Events in the World of Natural History

Reviews of New Books 441

Recent Publications for Those Interested in Nature

Editorial: Edward M. Weyer, Jr., Editor; A. Katherine Berger, Associate Editor; Dorothy L. Edwards.

Manuscripts should be sent to the Editor, The American Museum of Natural History, New York, N. Y.

Subscriptions: Natural History is sent to all members of the American Museum as one of the privileges of membership.

Advertising: Tom Davin, Manager of Publications, The American Museum of Natural History.

Publication Office: 10 Ferry Street, Concord, N. H.

Copyright, 1935, by the American Museum of Natural History, New York, N. Y.

Photo by A. L. Schuszler—Courtesy of Park Dept.

Wild Life in a City Park

For the urban populace who never see wild creatures in their natural state, zoölogical gardens provide a valuable educational medium. With modern methods of construction and management, even miniature zoos are able to exhibit a wide variety of interesting types

NATURAL
HISTORY
May, 1935

A Modern Picture Book Zoo

The reconstructed zoölogical garden in the heart of the great New York Metropolis

THE new miniature Zoo in Central Park, New York City, might well be followed as a model by many small cities unable to afford an extensive and expensive collection of animals.

Its compact design allows more than one thousand animals and birds to be exhibited comfortably in less than seven acres of park area such as most small cities possess within walking distance or trolley range of every citizen. Leaving scientific research to the larger institutions, this zoo aims primarily to instruct and amuse the people. That it succeeds is testified by the fact that it is the most popular spot in all the numerous park areas of Manhattan.

It has been called the "Picture Book" Zoo, because it exhibits all the primary types of animals such as are usually illustrated in a child's picture book. In a section which ordinarily would be devoted exclusively to lions, for instance, the Picture Book Zoo, instead of displaying a score of identical animals, shows ten or twenty different species of creatures. The Picture Book Zoo does not appeal solely to children, however, for according to Director of Menageries, R. Cheyne Stout, approximately 80 per cent of the visitors are adults.

One large harmonious family

One is impressed in walking among the clean, well-ventilated cages by the fact that the diverse collection is as harmonious as one large family. Every animal possesses a personal name of its own, and frequently responds to it. All of the lions and tigers, for instance, will come when called, and will allow their keepers to pat them or will even lie down to have their chests scratched.

Talented inhabitants of the Zoo

There is scarcely an animal in the collection which does not perform some little trick at the behest of a particular attendant. "Ink," a spider monkey of South American extraction, is always glad to shake hands with anyone who wishes to meet him personally, but needless to say he does not shake hands with all of the 72,000 that have been known to visit the Zoo in a single day. Jiggs and Anna, chimpanzees, like occasionally to be dressed up like human beings, and they appeared to enjoy the Christmas tree that was prepared for them as thoroughly as did the visitors who watched them play with the toys they received.

Capt. Cheyne Stout hopes that he may be able to have a special training cage, where demonstrations can be made to show the intelligence of the various animals. It is also his hope that other zoos similar to the Central Park Zoo may grow up about the country with the same facilities, so that variety may be maintained throughout by the exchange of trained units.

Of the thirty-five or forty men who comprise the working force of the Zoo, only the ten keepers and their four assistants are permitted to handle the animals. Thus they attempt to understand the psychology of each creature, its whims and prejudices, so as to avoid discontent.

A portable ultra violet ray outfit enables all the animals to receive the treatment regularly. Some of them "bask" under the actinic rays as often as once a day. The floors of all the cages are steam heated and constructed so that they may be easily cleansed by a flow of warm water. The washing of the floors occurs as often as half a dozen times a day.

The Culinary Equipment

The animals' diet kitchen is the last word in culinary design. There are two refrigerator rooms, one for meats and the other for vegetables. The chopping and grinding of food is done by electricity, with equipment that will accomplish anything from preparing French fried potatoes to grating nutmeg. Thus the dietary idiosyncracies of the animals can be taken seriously into account. All the cooking utensils are of heavy aluminum.

The veterinarian visits the Zoo every day, and there is daily inspection of all animals. For the smaller mammals, a special operating room is equipped with miniature operating table, illuminated by flood lights installed within the ceiling. The dispensary contains about $1000 worth of medicines.

Most of the animals of the Central Park Zoo have been acquired by donation. In addition, breeding in special enclosures provides surplus animals which are traded for new species from other institutions. Transactions of this sort are of course limited, however, by the general rarity of zoos throughout the country.

Only perfect specimens are accepted. The animal donated must be young, active, and healthy, and is admitted to the cages only after undergoing a period of observation in quarantine. The result is a conspicuously healthy collection of animals exhibiting a remarkable degree of animation and good temper.

The designers of the Zoo in their consideration for the welfare of the animals have by no means neglected the comfort of the spectators. One can dine in the spacious restaurant overlooking the glistening concrete pool where the seals are continually disporting themselves amidst the splashing fountains. The tasteful layout of lawns and hedges adds to the restfulness of the setting. And the animal houses are well ventilated and lighted.

A real backer of the Central Park Zoo has always been Alfred E. Smith. It was in recognition of his interest, therefore, that at the opening he was appointed Honorary Night Superintendent of the Zoo. He passes an average of three evenings a week there, and in the opinion of the caretakers, all of whom he knows by name, he performs the duties of a superintendent excellently.

Maintenance Costs

Zoos are not expensive to operate, Captain Stout asserts, if the buildings are modern and easily cleaned, if the force is experienced, and if the cages can be filled with fine, virile stock. The compact Central Park Zoo could be duplicated, he believes, at a cost which should not be beyond the facilities of many cities of approximately 100,000 population and upward. And once constructed, such an institution should be self-supporting.

SIX performing monkeys and a Tibetan sun bear have just been donated to the Central Park Zoo. These are the gift of Mr. and Mrs. Felix de Marce, exhibitors of animals, whose troupe they comprised. The de Marces are retiring from professional life and have chosen the Central Park Zoo as a pleasant home for their pets.

Katie, the Tibetan sun bear, rides a bicycle, it is said; whereas Booby, a Chachma baboon, prefers a motorcycle. Polidor, a bonnet monkey, distinguishes himself by imitating Charlie Chaplin, while Whiskey, one of two large rhesus monkeys, specializes in tight-rope walking. Others in the troupe are a long-arm baboon and a ring-tail monkey.

Shortly after their animal friends were lodged in the Zoo, Mr. and Mrs. de Marce made a call upon them to make certain that they were happy.

Mystery Island of the Pacific

An account of an extraordinary island and its strange civilization, visited recently by the Crocker Pacific Expedition

By H. L. SHAPIRO

Associate Curator of Physical Anthropology, American Museum

EASTER ISLAND, except to the Easter Islanders themselves, either means nothing at all, or it calls up a trinity of associations.

It is one of the most isolated spots on the globe, it contains a large number of huge monolithic statues, and it once had, until removed by travelers, a series of wooden tablets covered with an undeciphered script. These three phenomena and the speculation concerning them inspire the automatic appellation of "mysterious" whenever Easter Island is mentioned. And curiously enough that adjective does, in brief, explain the special interest that this island has for science as well as for the general reader.

Easter Island is usually regarded as having been discovered by a Dutch navigator, Roggewein by name, who sighted it on Easter Day in 1722. The claim is sometimes entered, however, that in 1686 the English buccaneer, John Davis, while cruising the South Pacific in the ship "Bachelor's Delight," was the first to sight it. The fact remains, nevertheless, that Davis' description does not fit Easter Island. Nor can Roggewein be said to have furnished us a completely reliable report. He described woods and forests where his successors have found none, and he mentioned seeing giants whom no other has ever discovered. The exact number of inhabitants in Easter Island at this period is rather vague. Roggewein casually mentions that "many thousand of these islanders came thither; some brought us fowls, with plenty of roots, others remained on shore, running to and fro, from one place to another, like wild beasts."

In 1770 Easter Island was visited again, this time by a Spanish expedition. Four years later that superb navigator, Cook, whose nautical skill was fittingly complemented by his perceptive abilities, landed on the island. From his account and from La Perouse, an equally famous Frenchman visiting Easter Island twelve years later, we obtain the first reliable impression of the character of the island and of the wonders it contained. They found it a grass-covered island lacking both wood and water, but rich in huge statues and elevated stone platforms.

The natives who greeted them were scantily garbed. For the majority, a meager fringe attached to the front of a narrow belt sufficed as a garment. Some few, however, wore in addition a shawl made of tapa, dyed yellow. Head coverings were constructed of bird feathers set into a circular band. Equally simple were the weapons displayed: spears tipped with flaked obsidian points and wooden clubs like those used in New Zealand. As in other Polynesian islands tattooing was extensively employed as an adornment, and elaborate designs covered face and body. The women painted their faces as well. It was observed that most of the islanders had perforated and extended the lobes of their ears to a prodigious size. A spiral of cane leaf was worn to keep the lobe at its maximum distension. Indeed, the entire life of the people appeared to be on a very simple plane as regards the materials of everyday life. And yet it astonished these visitors to see the exquisite refinement of their carving of small figures in wood.

It was observed that the islanders of both sexes would as soon swim out to greet their visitors as paddle in a canoe. The canoes, although not numerous, were extremely interesting. Small and degenerate in comparison with the elaborate double canoes of Tahiti, the Easter Island canoe was the product of necessity. The absence of timber on the island forced the natives to utilize every piece of drift wood washed ashore. From these miscellaneous fragments of wood, fitted together like a jig-saw puzzle, their canoes were constructed.

Cook took the population to be 600 to 700 in number. Forster, who accompanied Cook, reckoned it to be 900. La Perouse, however, estimated 2000. This discrepancy may be laid to the fact that Cook saw very few of the native women whom he supposed to be kept in hiding during his visit. In 1825 Beechey guessed the population to be 1500.

The list of succeeding visitors is not large. Easter has ever remained outside the common channels of oceanic travel and commerce, and it has had little of commercial value to attract intrepid navigators to seek its shores. In 1862, however, certain Peruvians decided that Easter Island very decidedly did offer a field of exploitation. A raiding party was organized and it descended on the defenseless island, carrying away practically all of the inhabitants to work in Peruvian guano fields. The alarming death rate among the islanders, following their transplantation, and the humanitarian protest of the French minister at Lima finally persuaded the Peruvian government to restore them to their island. Unfortunately, the restitution came too late, and a mere handful of survivors were set down on their native heath. Imported diseases among these people, lacking in acquired resistance, continued to reduce their numbers.

Later history of Easter Island

About this time (1864) a Catholic missionary from Chile visited the island and established a body of communicants. Catholicism has ever since remained the professed religion of the island, although no duly appointed cleric is at present resident.

In 1867 a Frenchman, Bornier, arrived from Tahiti, and, financed by Brander, a merchant at Papeete, acquired large tracts of land for sheep and cattle raising. Somewhat later, Salmon, also from Tahiti, took up extensive holdings. It is said that at this period the population had been diminished to 175. In 1888 Chile formally claimed possession of the island, and since no European power saw any advantage to be gained in acquiring it, it was permitted to remain under the egis of Chile. Finally in 1897 the Brander-Salmon property, which included practically all of the island, was transferred to Mr. Merlet of Valparaiso and eventually to Williamson-Balfour Company of the same city. This company runs about 40,000 sheep and has an annual clip of about 61,000 kilos. The station is under the charge of a foreign manager who employs about twenty or thirty natives as herders and workmen. Once a year a chartered vessel calls to remove the wool clip. Aside from this visit there are no regular boats of call, although unscheduled ships do stop occasionally.

The objects of our visit to Easter were to make a racial study of the pure-blooded Easter Islanders, to collect ancient crania and skeletons, and to cast a typical stone statue for reproduction at the American Museum. The successful issue of these projects was made possible by the generosity of Mr. Templeton Crocker, who organized the Templeton Crocker Expedition and led the party in the field.

The expedition arrives

For days, the yacht "Zaca," bearing the expedition, rode the long, unbroken swells of the South Pacific, plowed through mile after mile of vast, desolate seas, saw the Pacific change from a silken calm of violet and brown to a sullen, tortured mass of purple and white. And, finally, two weeks after bidding the Pitcairn Islanders farewell, when we had almost come to believe that the existence of Easter Island was, after all, a myth, we saw its gray silhouette on the horizon. It was magical. Moreover, it clinched in our minds the knowledge that Easter Island *is* remote — a lonely fragment of land, 2600 miles west of Valparaiso, 2750 miles southeast of Tahiti and 1400 miles from Pitcairn, the nearest inhabited spot.

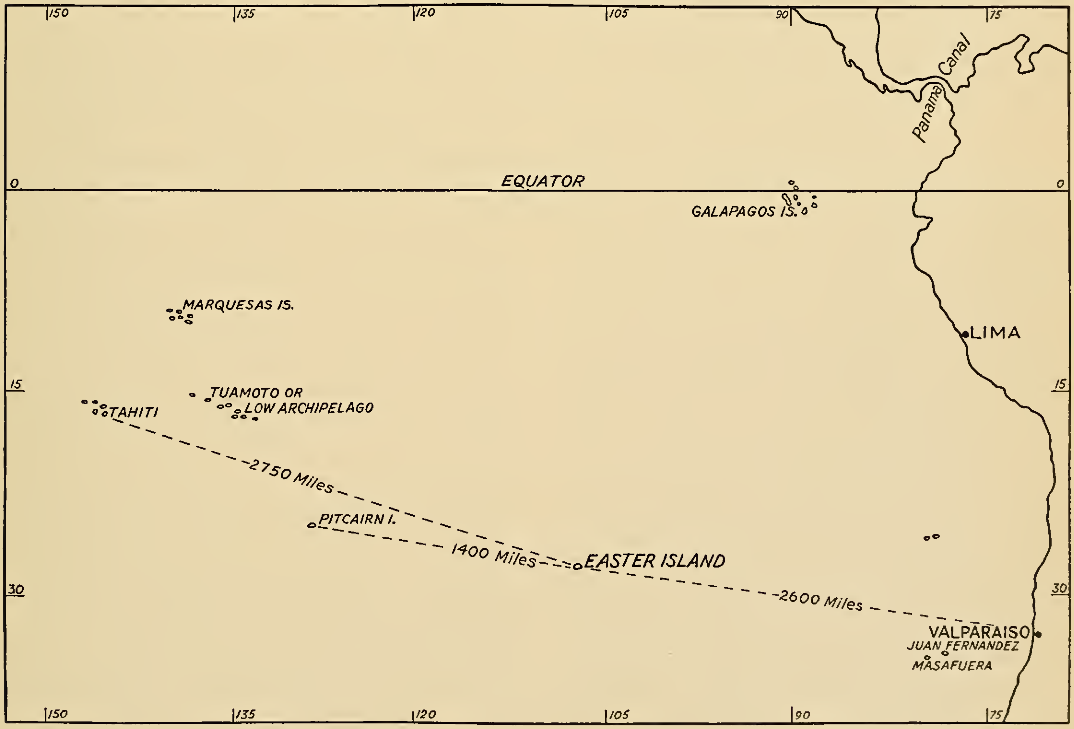
We sighted Easter in the early afternoon of January 13 of this year, and until we anchored off Hanga Roa at about 7 P.M. we spent most of our time watching the low-lying gray cloud gradually focus into a wheaten-colored treeless plain, dotted with volcanic cones. Except for a brush stroke of heavy green around the village, the prospect was more than desolate in appearance, and the disappointment of Cook on seeing this dry, brown island after a hundred days at sea could well be imagined.

We had no sooner dropped anchor than we saw a smart-looking boat put off from shore with an officer in command. The men were in uniform and displayed a true naval style. Our visitor was the Chilean administrator who was followed by a boat load of islanders. My interest in these visitors was naturally very intense. Their clothing consisted of cast-off odds and ends of naval uniforms. As they pushed forward eagerly with their curios, roughly cut stone and wooden figures, I could examine them more closely. I saw what I had anticipated. They were a mélange of Polynesian and every variety of European. But here and there a face gave me hope that perhaps the unadulterated strain of Easter Island had not yet completely disappeared. Discouraged, at last, by our reluctance to relieve them of their inferior carvings, they finally left but not without casting appreciative eyes over the graceful lines of the "Zaca."

There are now living on the island about 440 natives. Most of these are the descendants of the 175 survivors in 1871. A few Tahitians have settled here and intermarried, several Europeans have resided on the island for varying periods, and passing ships have provided still another source of miscegenation. But from among this mixed population, we were able, by careful checking, to segregate a small number of individuals whose blood had been uncontaminated by foreign admixture. This series of Easter Islanders revealed a type which, although Polynesian, nevertheless departed from it sufficiently to merit a sub-classification of its own.

The origin of the Easter Islanders presents a vexing problem to anthropologists. The reasons for this are several. Although linguistically and culturally the Easter Islanders have very close affinities with Polynesia, there does exist a number of non-Polynesian elements in the Easter Island complex. Moreover, the position of the island as the farthest extension of Polynesia toward the American mainland has encouraged some students to see it as a stepping-stone in a cultural causeway between Oceania and America. Mrs. Routledge, inspired by Balfour's comparative study of the bird motif in the art of Easter Island with similar figures from the Solomon Islands in Melanesia, has argued that a Melanesian migration reached Easter and mixed with one from Polynesia. This opinion is further supported by her interpretation of native traditions and by studies made on the ancient crania. Melanesian characters are said to exist in these skulls.

On this last point my own investigations are as yet too incompletely analyzed to be



ISLANDS OF THE PACIFIC OCEAN

The geographical isolation of Easter Island is manifest from the above map. Moreover, the island is outside the lanes of Trans-Pacific travel. Once a year a chartered vessel calls to remove the wool clips brought forth in support or in rebuttal. But from a preliminary survey, it seems probable that neither the results of blood groupings nor of anthropometric examinations will confirm the belief in a Melanesian strain. The blood groups are proportioned as in the rest of eastern Polynesia and no evidence of the frizzly hair or the flaring noses of the Melanesians was found.

As for the possibility of Easter Island as a connecting link between the Old World and the New, it is wiser to await a more complete demonstration. Needless to say the appetite for speculation far exceeds the food supplied. A discussion along this line would lead into much greater space than I have at my disposal and would involve hypothetical judgments on currents and wind effects.

The mere presence of man on this detached chip of land symbolizes better than anything else could do the nautical genius of the Polynesian. The courage which inspired the launching of slender, frail canoes into unknown seas, the hardihood which supported the men and their women during the long, hopeless weeks or even months out of sight of land, are heroic and give one an illuminating insight into the method of colonization in far-flung Polynesia. And more than this, it recalls the numerous tragic voyages which one successful landfall represents.

The ninepins of Rano Raraku

The second of Easter Island's threefold aspect likewise makes a vivid appeal to the imagination. The uneven lines of statues on the inner and outer slopes of Rano Raraku enhance the impression of mystery attached to the island. Lying face up or down, partly buried and standing erect, these monoliths, some as high as 30 or 40 feet, are tangible evidence of a once powerful social force. The questions which spring to the mind of the casual observer are the same as those which puzzle the expert and, in both cases, remain unanswered. How were they erected, these blocks weighing tons? How were they moved, frequently fifteen miles, and then set up on stone platforms? What was their significance? The guesses that have been made vary in plausibility. Some are purely imaginative, unfounded and improbable; others, more worthy of consideration, are the results of patient study by devoted students.

Below the quarries on the uppermost tiers of the inner and outer slopes of Rano Raraku are these Gargantuan figures, facing away from the beds from which they arose. Mrs. Routledge has denied that these statues which clutter the hillside were ever intended as a reserve stock from which suitable ones might be selected to be set up elsewhere. And the fallen and fractured images which define the ancient roads from Raraku have also been explained, not as abandoned in transit but as permanent monuments lining the road. The fact remains, however, that at various points on the coast stone platforms still exist with broken images at their bases. When Roggewein visited Easter Island these figures were standing in place. Later visitors found some fallen. Now, not one is upright.

Easter Island once a continent?

It has been postulated that a huge population was necessary to account for the manufacture and transportation of these goliaths in stone. La Perouse minimizes the difficulty by saying that a couple of levers and rollers were ample to move them. But levers and rollers of what in a treeless island? Some of the explanations are fantastic. Among those which have been offered are an overhead aërial railway and lubrication by grass and seaweed. It has also been suggested that the present island is the remainder of a once more extensive land now engulfed by the sea, following a cataclysm of some kind. This former, more extensive island, or even archipelago, it is added, had a much greater population — 10,000 or more — which might easily, by means of rope lines and great forces of men, move these images. Several arguments might be used against this hypothesis. It is not geologically proven that any cataclysm has affected Easter within the period of its human occupation. In fact the distribution of all its monuments are against such a belief. The image platforms for the most part follow the present coast line, which argues for its unchanging character. Finally, moving the images in the manner suggested, would result in breaking them, since they are carved from a friable and loosely cemented stone.

Even the purpose of these images is not clear. It is generally supposed that they were commemorative of chiefs or kings and erected after their death. Neither Cook nor La Perouse noticed any special worship paid them beyond a reluctance to walk within the limits of the platform. It has been pointed out that despite their unique character, they do bear a certain generalized similarity to the sacred images, or *tikis*, on other Polynesian islands. The Marquesan tiki, although of wood, had a platform support and was crowned with a red painted top like the red tufa hat surmounting the Easter Island images.

Casting an image

Even before we saw the sculptured monoliths on the flanks of Rano Raraku, we knew that with our equipment it would be impossible to bring back to the Museum one of those extraordinary relics. The next best thing appeared to be a cast. But the difficulty apparently was lack of water. All the accounts which we had diligently examined at sea made much of the absence of suitable water, and without that a cast was out of the question. We discovered, however, on reaching Easter Island that the extinct crater of Rano Raraku contained a lake from which water might be obtained with ease. The next step was the selection of a statue. It was necessary to settle on one that was typical and at the same time complete and in a position adjusted for the needs of casting. Those on the outer slope were not only too far removed from the source of water, but were too large. Even if we had the facilities for casting these 30- and 40-foot figures, their reproduction might prove embarrassing at the Museum. The choice, therefore, narrowed down to the statues on the inner slope. These were of a more manageable size and were close to the edge of the lake. The statue finally chosen was about 10 feet high and had the conventional characteristics of these monolithic figures.

Under a broiling sun and surrounded by a cloud of insects, Mr. Toshio Aseida labored for days taking molds of the figure. The cast was made in sections, each carefully numbered, and will be eventually displayed in the Museum.

Besides these relics of a former civilization, Easter has other archeological vestiges. Stone cairns, burial platforms, enclosures and walls of various sorts dot the island. Constructed of the ubiquitous volcanic rock, fragments of which lie scattered over the land like a rash, they constitute the most numerous of the ancient monuments.

Ancient house foundations are found in great numbers in certain parts of the island. These are long ellipses, averaging about 50 feet in length and 6 feet at their widest. The largest is 120 feet by 12. Neatly dressed stone blocks, accurately fitted to the lenticular curves, define the former walls. Each block had one or two holes on its upper surface. From the accounts of early voyagers, we know that into these holes were let poles which were then joined to form an arched framework over which thatch was spread. The entrance to these inverted canoe-like houses was very small. La Perouse says that these dwellings were bare of furniture, the floor was covered with grass and mats, and that they were apparently used only for protection against the elements.

Another type of structure has also been reported. This is a kind of stone tower. Its use as a watch tower has been suggested by Mrs. Routledge, but Skottsberg is inclined to consider it impractical for that function.

The stone village

But the most extraordinary collection of remains are the stone houses in the village on Rano Kao. These are connected with the peculiar bird egg ceremony and are located on the southeast ridge overlooking the crater of Rano Kao on the one side and the rocky islets off the coast on the other. Built of laminæ of rock, the wide, flat stones are neatly piled into walls, the upper tiers of which overstep and converge to form a corbelled arch. Long and narrow like the "canoe" houses, they were, however, much more pretentious. The inner walls were often lined by upright slabs, some of which were painted with symbolic and conventionalized designs. The entrance is a narrow tunnel from 4 to 6 feet long, and requires a prone position and considerable squirming to make the passage into the interior of the house which usually consists of only one room, on the average about 20 feet by 5 feet. One we explored had another chamber to the rear. Damp, earthy, and devoid of any light, this adjunct cell was distinctly unpleasant. It is inconceivable to suppose that these dwellings provided anything more than a protection, certainly no one would choose to remain within. Although many of these houses have been partly destroyed by visitors, enough remains to show their original character.

Once a year, when the sea birds arrived at the breeding season, the islanders gathered at this village. From the sheer cliffs overlooking the tiny, rocky, bird islands, various contestants would swim to the islets, and the first to return with an egg was proclaimed king for a year. Perhaps commemorating the ceremony, "bird men" are cut in low relief on a multitude of rocks in the vicinity.

During the period of encampment in the stone village of Rano Kao, waiting for the supreme moment of the egg race, the residents passed their time in dancing and feasting. The latter activity involved, on occasions, the rite of cannibalism. The human victims were consumed in a cave in the sea cliff near the village.

Egg races

Although the egg race was competitive, it was confined to certain people. Only members of the *Ao*, or ruling, clan were admitted and these were especially designated by supernatural means. A prophet might dream that a certain individual was in divine favor, thus bestowing on the favored one the right to enter the lists. The winner not only became sacrosanct but he also adopted a new name which was given to the year of his victory.

Usually the competitors were men of some importance. They ordinarily selected servants who entered the race in their behalf. While their principals were living in the stone village, these representatives dwelt in a cave on the islet awaiting the arrival of the birds, the first egg of which was so eagerly sought. Mrs. Routledge states that it was the manutara, or sooty tern, that furnished the sacred egg of this rite.

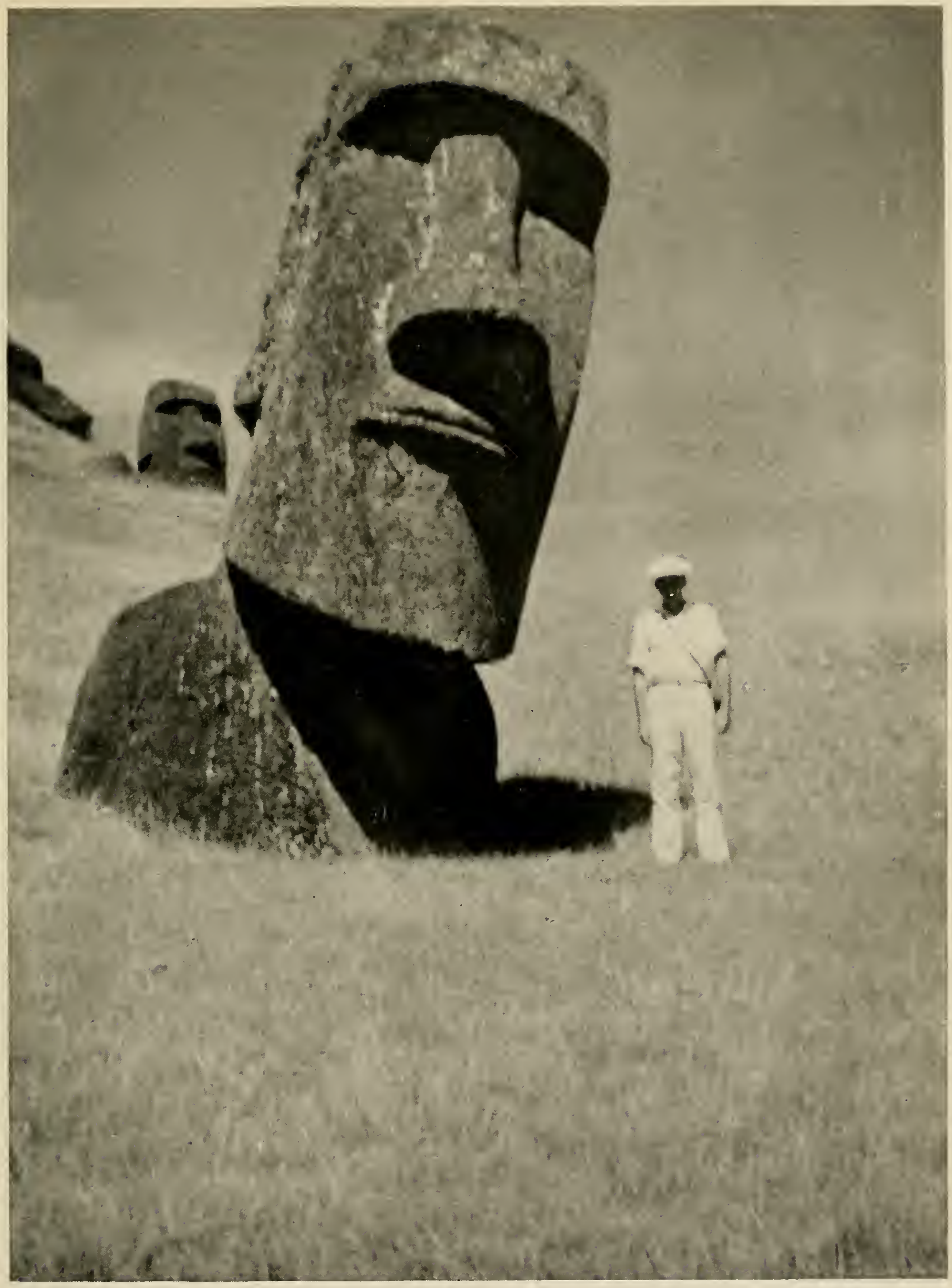
The detailed description of every point of interest in connection with Easter Island might easily require volumes. Mrs. Routledge has filled one fat book and she has not exhausted the possibilities. I cannot, however, close this very brief and incomplete sketch of Easter Island without a final mention of the strange script once found there.

The curious can see the original tablets at only a few museums in the world. They consist of lines of hieroglyphic-like outline figures arranged in rows. To save the precious incisions from rubbing, an ingenious method was adopted. The wooden tablet was very slightly grooved, and the hieroglyphs were incised in these grooves, the ridges between the grooves thus preventing contact with the face of the script. Although a number of reputed translations of the tablets have been offered, no one has ever been authenticated, and the script has remained undeciphered.

It has been reasonably suggested that these tablets were in the nature of mnemonics. Thomson relates that he exposed one old native's claim to be able to read the tablets by secretly replacing the photograph of another tablet for the one the native thought he was reading without the substitution being detected. Nor could Thomson's translator decipher a character when taken from its context. Thomson suggests plausibly that the story of each tablet might have been memorized and that a recitation of this tradition had replaced an actual reading of the characters.

Recently, the characters found on seals in the ruins of Mohenjodaro in the Indus Valley and dating to the third millennium B.C. have been compared with these Easter Island characters, and a strong resemblance between certain ones is evident. It is too early as yet to accept unquestioningly this preliminary comparison. But should it prove incontestable, it will provide another connecting link between Polynesia and India, an association which has already been suggested by other evidence.

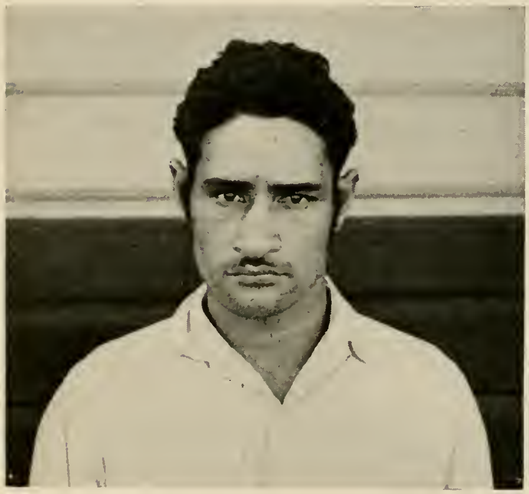
◆



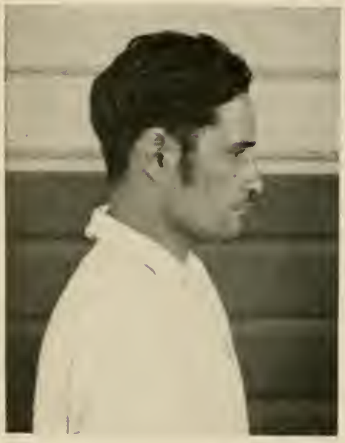
Monuments of the Past

The handiwork of Easter Islanders of centuries past survives in these monstrous statues. The economy in the use of planes is noteworthy, and, contrary to the opinion of early visitors, represents a high degree of skill. The illusion of reality is heightened by distance. A cast of one of these figures was made for the American Museum

A VIEW OF EASTER ISLAND



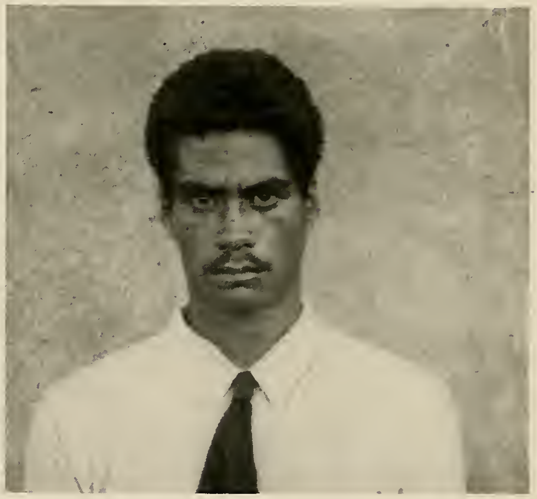
The above panorama of the island was taken from the south and shows its flat, plainlike character, relieved by extinct volcanic cones like ant hills. The cliffs on the left contain the crater of Rano Kao and the ancient stone village where the annual bird-egg ceremony was celebrated

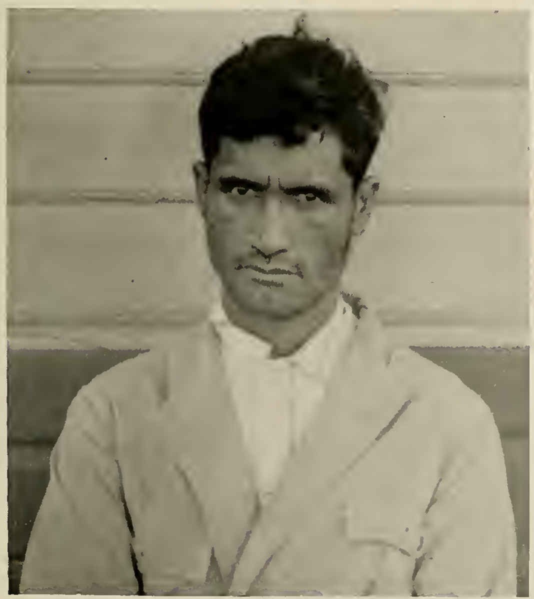


The typical islander has a very narrow and long head as well as a narrow face

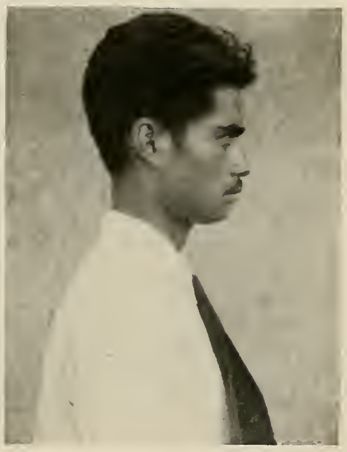
AND SOME INHABITANTS

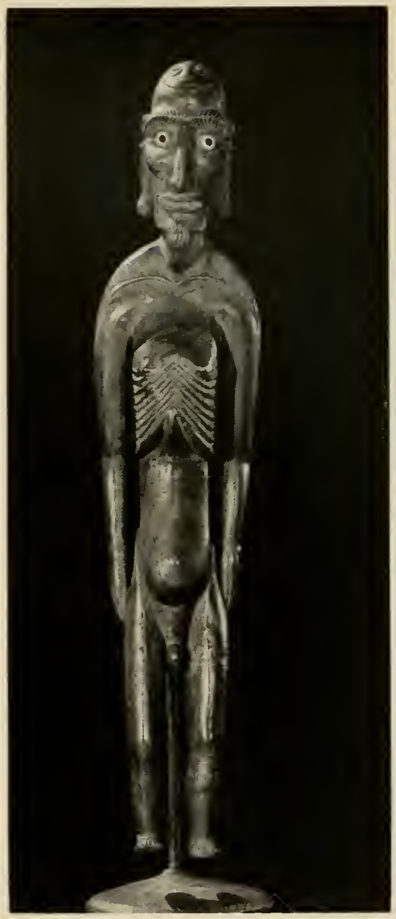
The population of Easter now contains about 440 persons most of whom are mixed with Europeans. The men on this page are reputed to be pure-blooded Easter Islanders. They resemble to some extent their relatives, the Polynesians, but they form a sub-group with special characters of its own



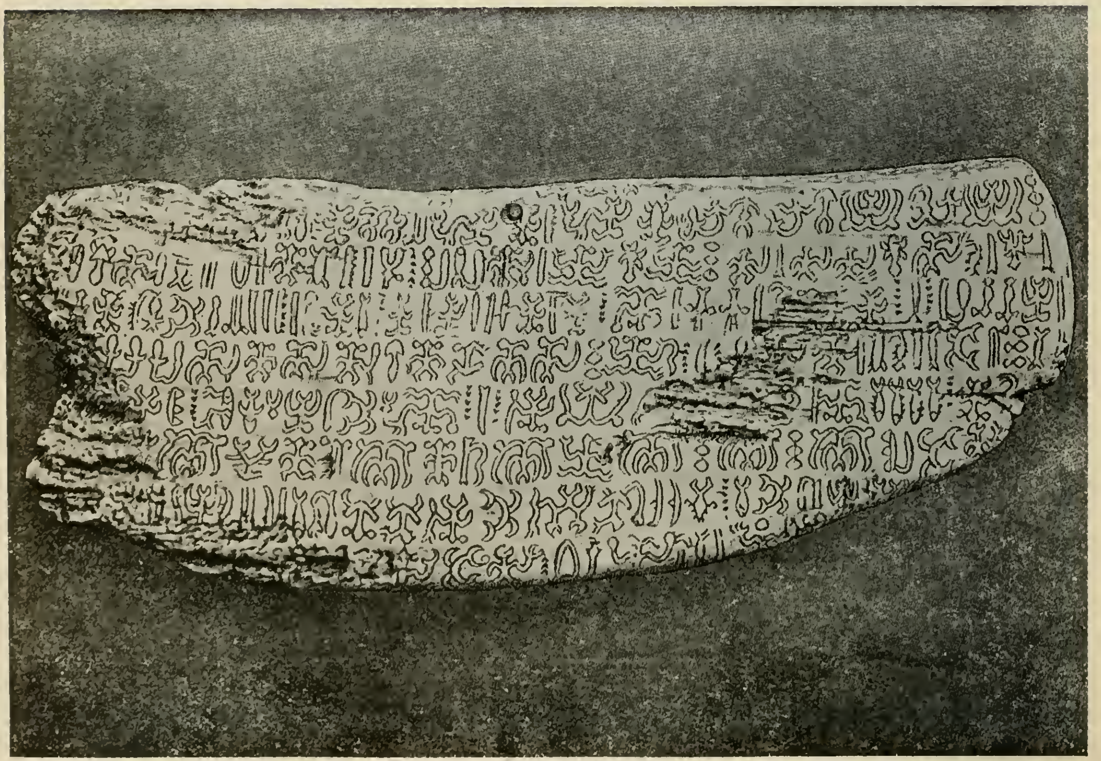


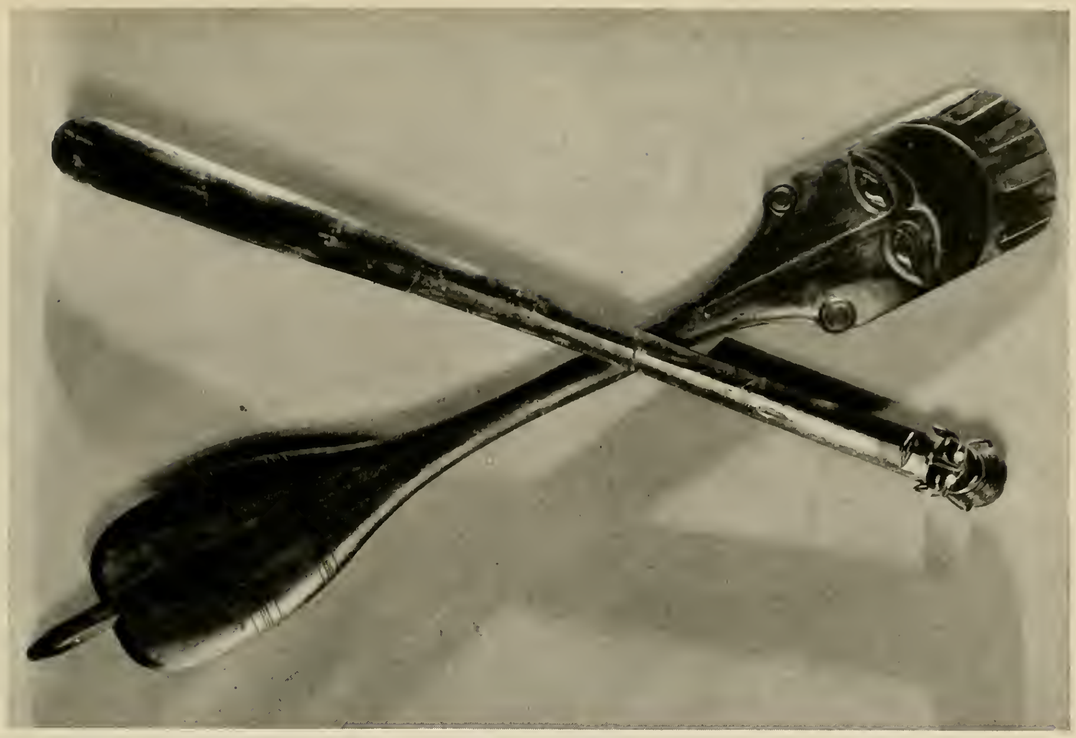
The man on the left represents a Caucasian-like element common in eastern Polynesia



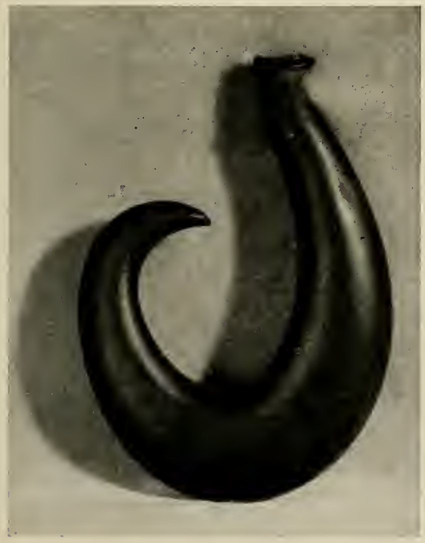


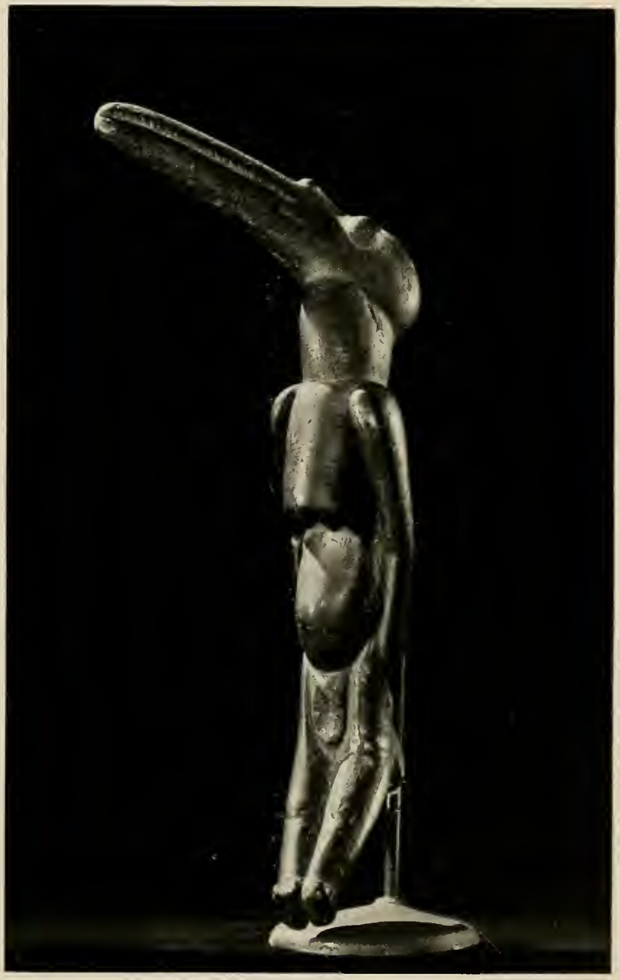
The objects on this and the following page are in the collection of the American Museum of Natural History and illustrate part of the material culture of Easter Island. The woodcarving skill of the Easter Islanders is well illustrated by the figure in the upper left hand corner and by the "bird man" in the lower right of the next page. Stylism is frankly employed in these objects



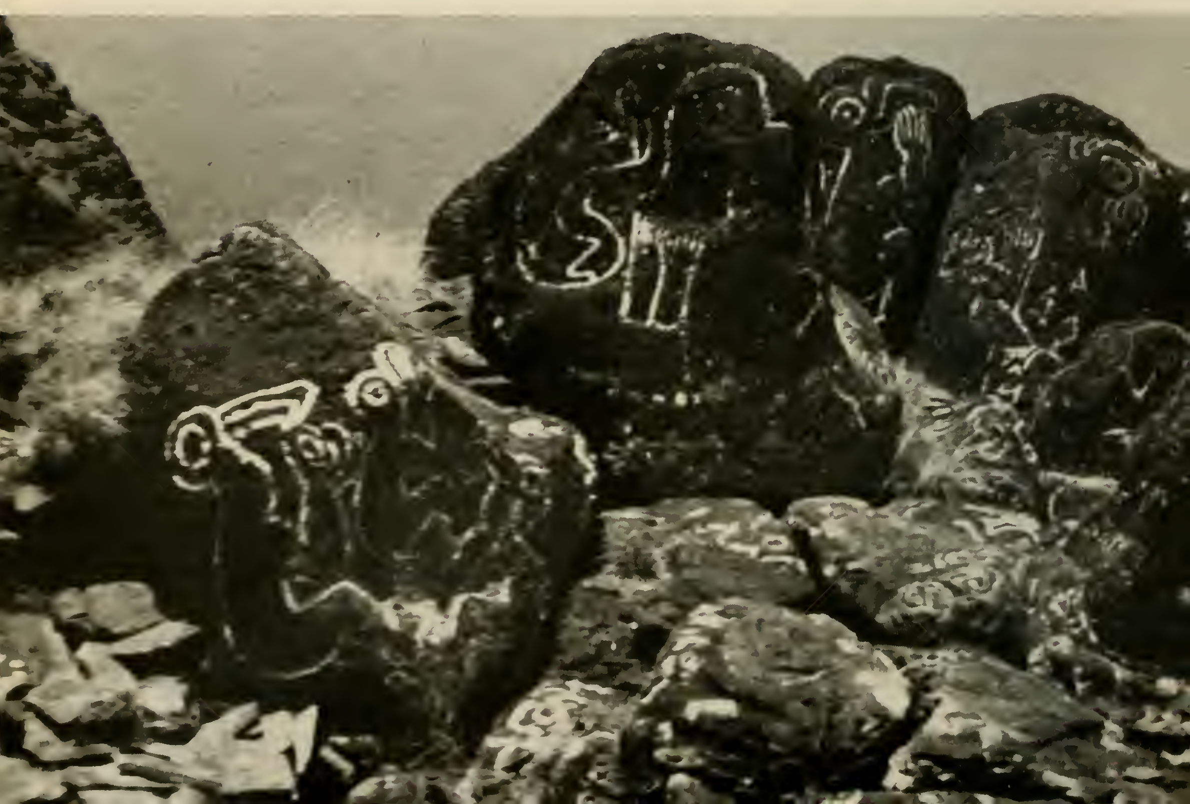


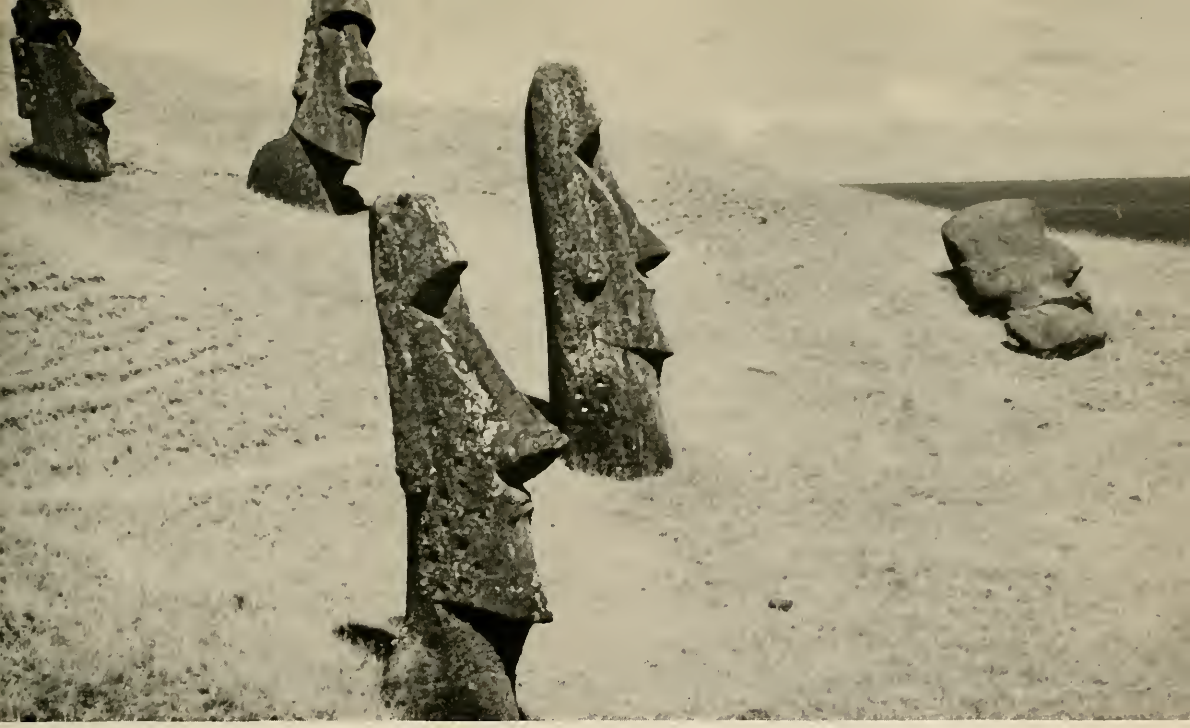
The basket shown at the top of the opposite page is made of rushes, and is unlike those employed in other Polynesian islands. Below on the opposite page is a cast of a wooden tablet covered with the undeciphered script, formerly read by the natives. The picture on the upper half of this page shows a ceremonial dance paddle and a club. The heads on both are Janus-like. Directly below is a rare stone fishhook





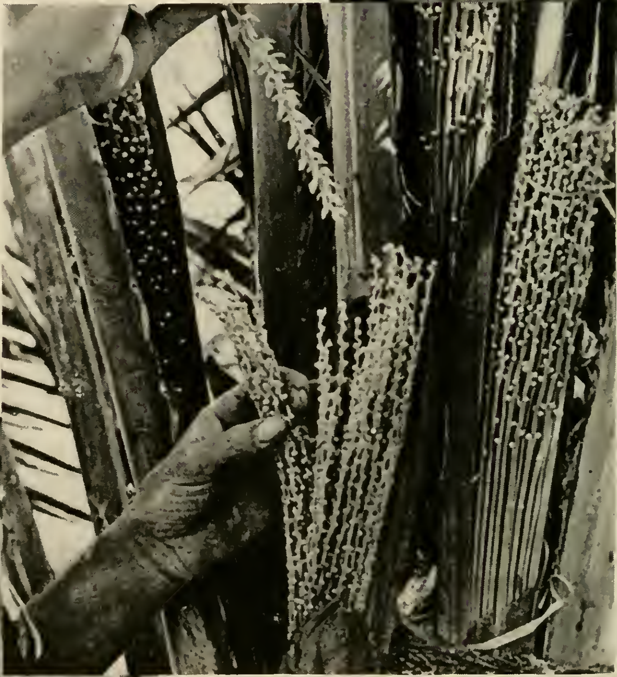
The above photograph represents an image platform upon which statues similar to those pictured on the facing page were set. The images which formerly occupied these platforms wore huge circular hats of red tufa. Below are a group of carvings, representing "bird men," on the rocks near the stone village on Rano Kao





The slopes of Rano Raroku are dotted with images like those shown above, whose immutable and pouting expressions lend an air of strangeness to the scene. Many, however, have fallen and are in various stages of exposure. The one shown to the left seems in comfortable repose. Below, the stone foundation of an ancient "canoe" house is illustrated

Soil and climate in the desert valleys of Arizona and Southern California combine to make ideal conditions for the propagation of dates of unexcelled flavor and quality. In 1900 the United States Government first interested itself in the possibility of growing this fruit in the desert stretches of the Southwest; today nearly 10,000 pounds of native dates are harvested from an acre of this once arid soil



Above: Transferring pollen from a male blossom to the female blossom. This must be done by hand, since nature has provided inadequate means for accomplishing this. In the wild state, it is done by the wind

Left: A cluster of ripening dates. All the dates in a cluster do not ripen at once, but are gathered separately as they mature

American Date Gardens

A staple food of the peoples of desert regions in the Far East becomes acclimated to the arid conditions of the American Southwest

By EMMY MATT RUSH

THE date palm is one of the oldest, if not *the* oldest, food-producing tree in the world. From time immemorial the people of the desert areas of the Far East have thrived upon its luscious fruit, and it has been utilized as a basis of food supply down through the ages of man.

When the United States Government began its search for a fruit tree that would withstand the arid conditions of the desert stretches of the Coachella Valley in the Colorado Desert of Southern California, Government horticulturists turned their search into the desert areas of the Sahara, Algeria, Persia, and the Nile Valley.

"*Date of Light*"

Numerous varieties of date palms were subjected to experimentation, with the result that today the greatest romance of the fruit industry of America is that of the date palm both in Arizona and more particularly, perhaps, in Southern California. Due to the virgin soil and the unique climatic conditions of the desert valleys of the Southwest, the date of America excels both in flavor and quality. In the Coachella Valley, especially, the silt of a prehistoric sea, the glorious sunshine of the area with its so-called "violet rays," and water, unite in producing some of the finest dates grown for the consumption of man. And of these, the far famed "deglet nour" . . . date of light . . . ranks supreme.

Concerning this unsurpassed variety of date, which is of far eastern origin, a legend comes down to us. A young maiden early in life lost her mother whom she loved devotedly, so the folk tale runs, and thereafter she went daily to the grave carrying with her a rosary made of a string of date pits. One day she failed to return from her little pilgrimage of prayerful devotion. Seeking her there, her father, a date planter, found the girl lying dead across the mother's grave. Clasped within her hands was the broken rosary of date pits. In after years a new kind of date was found growing where the dead maiden's body had been discovered. It was a beautiful, bronzelike fruit, almost transparent, unlike any variety of date that the East Indian growers had yet produced. The father pronounced it "deglet nour" — the date of light.

The Coachella Valley, a veritable paradox of nature, glamorous and mystical, lies to the southeast of Los Angeles; as a crow flies, the distance is approximately 125 miles. Where drifting desert sands are blown by the caprice of desert winds, where cacti greet the gold and purple sage and grease wood and mesquite, where America's only native palms, the *Washingtonia Filiferia*, dip their roots in the meandering streams that wander desert-ward from snow-clad heights of San Jacinto's rock-ribbed canyon walls, the conception and the culminating achievement of one of America's most heroic horticultural experiments has for its fundamental basis a territory rich in virgin soil and the silt of a prehistoric sea of a forgotten era. Here nature in her maddest, gladdest, and saddest of moods, makes manifest her variety, amid sand dunes ages old. It is here that America grows her dates.

The pioneer date grower

In the early days of the industry many enterprises failed. The discouragements which assailed the pioneer date grower are too dismal to relate and are known only to him. But he who defended his "lay-out" in the bottom lands of a prehistoric sea at the base of the Santa Rosa Mountains, with American pluck and determination, and trusted in that unique triangle of earth, sun, and water, won the battle. The date grower of Coachella Valley plowed his way through sand dune, wind, and despair, to success.

The mountain streams of this area are dryer than rattling parchment during the summer months, the silt of the prehistoric sea "cakes" like a mass of glittering quicksilver under the powerful rays of the desert sun, and what has every appearance of a mid-winter snow storm, upon investigation proves to be the backwash of the ages, tiny white pearl-like sea shells, uncovered by the long arm of the desert wind!

Irrigation

With a summer heat that registers from 120° to 140° Fahrenheit, the date gardens of the Coachella Valley are irrigated every ten days. There is another East Indian legend to the effect that the date palm must have its feet in water and its head in the fires of heaven. The factors and elements of nature that for ages have nourished the thorn-covered flora of this region, today feed date palms that were brought here from Algeria and the Sahara.

The most remarkable native flora of the Coachella Valley desert, perhaps, is the beautiful native smoke tree. Found nowhere else in the world, it is said, except in the great Desert of the Sahara, the lacelike, thorn-tipped, bluish tendrils of this unique desert variety, was first called "smoke tree" by the early Spanish colonists who crossed the sands here en route to a new world, believing that they were approaching a desert fire.

The brooding, sweeping, sand dunes and the cacti-covered mesas, shifted by the caprice of the desert winds, are slowly but surely making way for date gardens of the modern American grower. From Santa Rosa's spurs as far as the eye can see, one beholds the broad expanse of the Colorado desert and its valley lands, the Salton Sea, and the coral-encrusted reefs with their cryptic inscription, and scattered across this wide range one beholds that more modern institution, the American date gardens.

It was soon discovered that the deglet nour, "date of light," imported from Algeria, best adapted itself to the climatic conditions of the Coachella Valley. More than three thousand acres planted to date palms now bearing fruit, set out in the trenches of the virgin soil of this great valley, today tell the story of the startling and romantic career of the date industry in California. Sand dunes had to be leveled, underground desert waterways had to be tapped and the water brought to the surface, and young shoots set out.

Date culture has become a matter of horticultural study that carries the reader back to the year 1900, when the United States Government first began to interest itself in the possibility of growing dates in the Southwest. Today, thousands of tourists annually trek hither to see for themselves the actual achievement of this great horticultural enactment.

It is claimed that various species of dates can be arrived at only by the planting of seeds, each seed producing, strangely enough, perhaps another variety of date. At the same time, however, a desired species of date may be propagated by utilizing the young shoots that are sent out by the parent tree near its base. The parent tree will send out from five to twenty-five of these young shoots during the first ten to fifteen years of its growth. One date grower with a ranch near Indio, claims that his place boasts 119 varieties of dates grown from seeds.

Fruitage

After the young shoots have developed a root system of their own, they are in turn planted out in rows forty-eight to the acre, and one of the growers confided to me that it requires *eight years* and costs from $4000 to $6000 to carry *one* acre of date palms to the point where they begin to earn some money for the grower. You will decide that date culture is not a poor man's job. Be that as it may, a grower, it would seem, earns every cent his date garden nets him after the long years of labor, time, and money involved. The date palm, however, upon reaching the mature point of bearing fruit, rapidly begins to repay its owner.

The female of the species produces from eight to twenty blooms that hang like gorgeous festoons between the palm leaves. Each tree will produce from 100 to 350 pounds of fruit, depending largely upon the tree and the care it receives. A date palm in a well cared for garden will reach a height of from eighty to one hundred feet.

The male of the species does not bear fruit, and strange as it may seem, nature by some curious twist or caprice, has provided no adequate means for transferring the pollen from the male blossom to the female bloom. And, notwithstanding the fact that the date palm is the oldest known cultivated fruit tree in the world, history tells us that it has been pollinated by hand, by man, for thousands of years. If you think a date grower doesn't work overtime, at all times, listen to what Mr. Date Grower told me about the process of hand pollinating the date palm.

"We cut the blossoms off the morning they open," said he. "Then we dry them, and we shake out the pollen. We then collect the pollen on cotton billets that look like powder puffs. The pollen is then dusted by hand on the female bloom within three days after it has opened."

The Coachella Valley date grower begins the process of hand pollinating his date palms about the fifteenth of February. This continues until about the first week in May. The fruit begins to ripen about the fifteenth of September, and this continues until about the first of January.

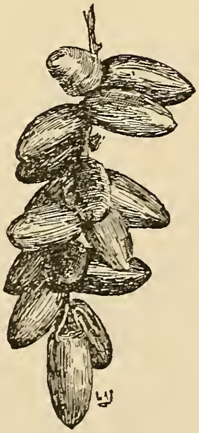
All of the dates on a cluster do not ripen at the same time. Each date, as it ripens, is hand picked from the cluster by Mexican pickers trained for this service. The fruit is carried in field lugs to the packing houses where it is thoroughly cleaned.

Sometimes some of the growers find it desirable to "process" their fruit, by giving it a coating of heavy syrup. The "unprocessed" natural date, however, is more desirable, for it retains all of the qualities of the natural flavor, as well as its beautiful bronze cast.

Almost a complete food

It is claimed for the date that it carries a remarkable combination of the foods necessary for the human body. Sugar is associated in the date with protein, the necessary tissue builder; also iron, for the blood; lime, essential for the bones of the human body; and vitamines for nutrition and stimulation of growth. At the same time the necessary laxatives are not lacking in the date . . . no "pink pills" if a handful of tree-ripened dates are consumed. A date palm is at its prime when it reaches the ripe old age of one hundred, thus refuting all theories as to the uselessness of old age. It is said that there are date palms in the Mother country of the date whose ages run well into three hundred years.

Nature has not dealt unkindly with the Coachella Valley and the Colorado Desert land. Today approximately 10,000 pounds of native dates are garnered from one acre of this once arid soil, land apparently worthless only a short time ago . . . land that has been the homing place of rattlesnake, coyote, and wolf . . . land that is rapidly being reclaimed by American pluck and American grit. The spirit of the pioneer still lives.



An American Seedling Date

The Petrified Forest

Turned to stone as they stood upright in the forest, layer upon layer of fossil trees form a fascinating display in a rarely visited part of Yellowstone Park

By WENDELL *and* LUCIE CHAPMAN

Photographs copyrighted by Wendell Chapman

THE term "petrified forest" usually brings to mind the colorful fossil logs in Arizona, the huge trunks in Napa Valley, California, or the scattered pieces in the vicinity of Cairo, Egypt. As a matter of fact, these displays are not forests at all in the true sense of the word. The term "forest" implies innumerable standing trees. The "trees" in each of these celebrated districts lie about in a horizontal position.

However, there is a district in Yellowstone Park and extending beyond, where forests have been entombed and the trunks have been petrified in an upright position. Roots of stone are embedded in stone, fossil leaves, twigs, and cones often lying about in the crumbling rocks. And these petrified forests are in layers, a dozen piled one on top of the other. Why then are they not better known? Why should such great natural wonders remain comparatively obscure?

There are several reasons. In the first place, the most remarkable displays of these forests are several miles from the roads, and are located in widely separated districts. In the second place, people who visit this section of the Rocky Mountains are attracted by the more widely publicized and more easily accessible phenomena of Yellowstone Park. Moreover, the few local residents of the sparsely settled adjacent country who do visit the displays have little opportunity to advertise them. Furthermore, the vacation weather lasts but three or four months each year, and even the visitor with unlimited time does not have an opportunity to see everything within this enormous country.

Few members of the Park Service have been able to take time to visit the most remarkable exposures in the Gallatin Range which extended within and beyond the northern boundary of Yellowstone Park. This corner of the Park was opened by highway only a few years ago. It is strange, however, that scientists making reports on the Fossil Forests of Yellowstone have failed to visit these most fascinating and abundant displays. In a short report of the Carnegie Institute as late as 1933, Charles B. Read made his observations from a district in the Lamar River Valley, apparently unaware of the superior displays in the Gallatin corner of the Park.

These forests, which would have become renowned and would have been ample reason for the establishment of a national monument if they were off by themselves, have been overshadowed by near-by painted canyon walls, magnificent waterfalls, the world's greatest geyser activities, and the most complete collection of wildlife in the United States. Some of the most interesting districts of these petrified forests are almost unexplored. Nature has been lavish in the Rockies.

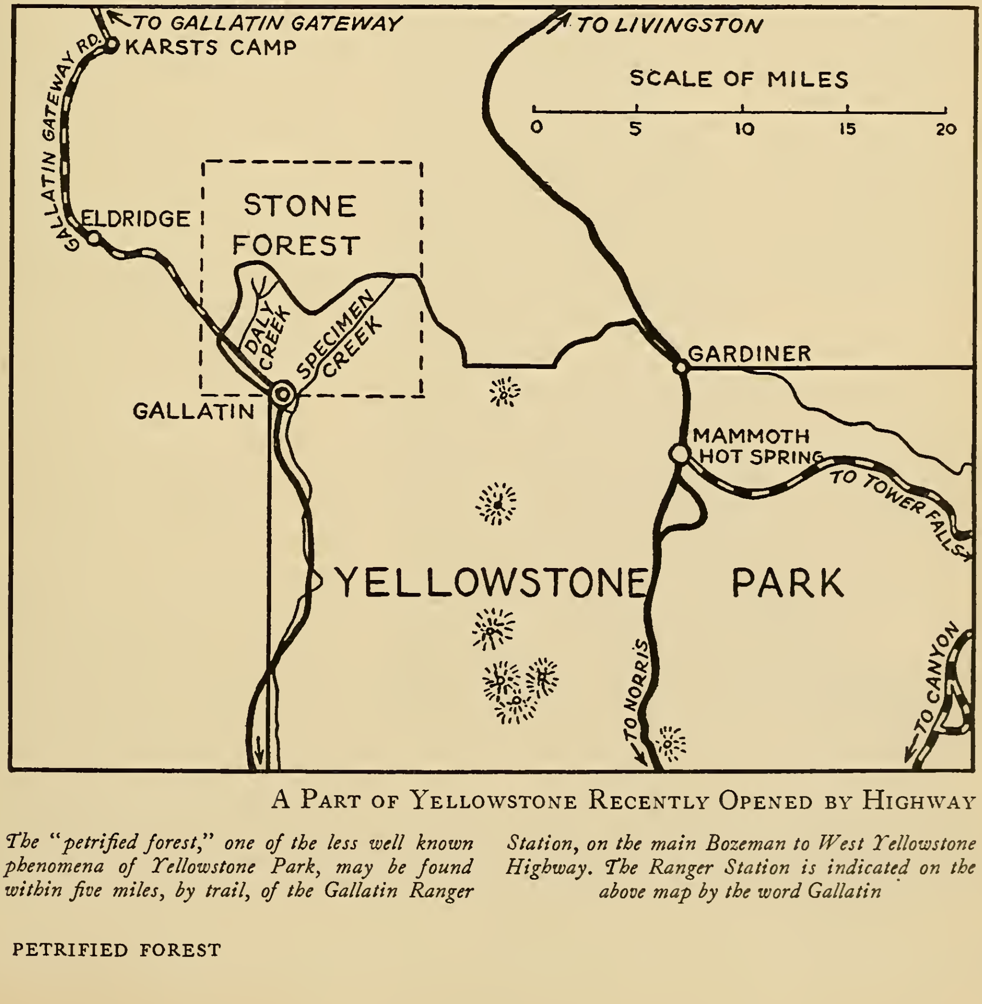
Stumps from three to twelve feet in diameter dwarf the living trees, which seldom attain a diameter of three feet. These larger trunks suggest a very different type of vegetation in ages past, as indeed do the rest of the 150 species of fossil plants that have been found in the Park.

At present the forests are essentially evergreen, lodgepole pine predominating. Englemann and Douglas spruce are next in abundance. Two small varieties of pine, two of fir, and a juniper, which is in reality little more than a shrub, complete the list of evergreen trees growing there now. The deciduous trees are represented by quaking aspens and an occasional cottonwood. There are also willows, alders, a small birch, and shrubs.

In contrast to the predominately coniferous forests of the present, the fossil remains show that although the forests of the past contained three kinds of conifers — redwood, ewe, and pine, which apparently dominated in numbers, the greater variety was in the deciduous list. It included walnuts, hickory nuts, poplars, birches, hazelnuts, beechnuts, chestnuts, breadfruits, oaks, elms, figs, magnolias, laurels, bays, cinnamons, sycamores, acacias, sumachs, persimmons, maples, and dogwoods, in addition to grapevines and many others. Such vegetation flourishes in a more moderate climate than prevails at present.

The largest stumps are from the *Sequoia magnifica* forests of recent geological times and are said to be a species undistinguishable from the redwoods growing along the coast of California today (*Sequoia sempervirens*). The prevalence of these magnificent trees which grow now in milder climates indicates that if people had lived in this region about a million years ago, they might have developed a superiority complex over their California climate. Undoubtedly they would have pointed out two or three different redwoods, each of which by ingenious qualifying conditions might have been "the biggest tree in the world." What a pity the climate, too, was not petrified!

The first white man to see and report these forests undoubtedly was James Bridger, one of the greatest mountaineers and rovers the West has ever known. It is thought that he first saw some of these petrified forests in the 1830's during his solitary wanderings. Few wonders escaped his notice, but his descriptions of the strange things he saw soon gained for him a Munchausenian reputation. Learning that people would laugh at his embellishments when they would not believe his facts, and having been naturally susceptible to megalomania which probably reached its very zenith in the early West, Bridger produced some whoppers. Spurred on by people's craving for amusement rather than instruction, he described the petrified forests of what was to become known as the Yellowstone region of the Rocky Mountains as "peetrified birds a sittin' on peetrified trees a singin' peetrified songs in the peetrified air. The flowers and leaves and grass was peetrified, and they shone in a peculiar moonlight. That was peetrified, too."



A Part of Yellowstone Recently Opened by Highway

The "petrified forest," one of the less well known phenomena of Yellowstone Park, may be found within five miles, by trail, of the Gallatin Ranger Station, on the main Bozeman to West Yellowstone Highway. The Ranger Station is indicated on the above map by the word Gallatin

Although Bridger's description was a bit magnificent, like the country in which he roamed and the statements of the acquaintances with whom he vied, the fact that he saw the petrified trees, recognizing and describing them as such, is indisputable.

"Old Jim Bridger's lies" concerning the petrified forests were found to be based upon facts when the Hayden Survey Party made a scientific study of the Yellowstone Park region in 1878. Mr. W. H. Holmes, who accompanied the party to make the geological reconnaissance, made a special study of the petrified trees. Although he was unable to find anything like a complete exposure of the superimposed layers, nevertheless, from the scattered stumps which he did see in the Lamar River Valley, he was able to visualize the strata.

He must have spent weeks gathering and piecing together fragmentary bits of information, before drawing the diagram which, with minor changes, is still used in geology text books. Had he only known it, a cliff some fifty miles to the northwest would have revealed almost the complete story, at least eight layers of petrified stumps being clearly visible from one spot. Holmes's diagram has induced many enthusiastic visitors to climb the celebrated Specimen Ridge overlooking the Lamar Valley, only to find a few petrified stumps. They, too, should know of the cliff which can now be reached by a ten-mile hike from the highway traversing the Gallatin corner of the Park.

Tremendous Eruptions

How these forests came to be preserved and piled on top of one another is explained by geologists to be the result of a series of tremendous eruptions similar to those which covered Pompeii. From craters or fissures dust and rocks were showered out in sufficient quantities to cover many square miles as much as fifty feet deep in a single "hailstorm."

As the rocks and débris came plunging to earth, they stripped foliage and limbs from the forests, leaving the standing trunks. Later, water eventually permeated the layer, carrying silica in solution and slowly turning the embedded trees to stone.

In some stumps the process of petrifaction has been interrupted, and in the same tree section is found perfectly petrified wood with adjoining fibers of almost unaltered wood. Such incomplete silicification is undoubtedly due to an interruption of the necessary conditions, such as withdrawal of silica-carrying waters, rather than to insufficient lapse of time.

Petrifaction can take place quite rapidly under proper conditions, as is illustrated by the pieces of wood which have been in the silica-carrying waters of Yellowstone Park recently. When removed, these pieces often have the appearance of completely petrified wood, although, upon being dried and broken, some will burn. This stage of petrifaction has taken place in pieces known to have been thrown into the pools since the park was established in 1872 — which is no time at all as geologists figure it.

Buried Forests

To return to the buried forests, while petrifaction was going on beneath the surface, another forest was developing on the surface. After hundreds or thousands of years, when the trees were growing nicely, presto, another shower of rocks and ash, and a second forest was sealed in a layer of breccia for permeating waters to turn to stone. This reforestation followed by inundation of volcanic débris recurred over the same areas at least a dozen times and, although many thousands of years were required for the 5000 feet of these deposits to be laid down, still the whole series of eruptions probably happened within one or two short epochs of geologic time.

You may recall that geologic time is divided into four great eras, the last of which is divided into six epochs, the Eocene, the Oligocene, the Miocene, the Pliocene, the Pleistocene, and the epoch in which we live, the Recent. The fossil forests of the Yellowstone district have long been assigned to the Miocene. However, recent study has unearthed evidence that they may have been formed earlier, in the Oligocene or Eocene. (According to Read — Carnegie Institute *Report,* 1933).

A tourist who attended a lecture on geology in Yellowstone Park one evening after having visited the boiling caldrons, the hissing steam vents and the roaring geysers, was so much impressed by an account of these buried forests that she went trembling to the lecturer and asked if he thought there was any danger of another eruption coming soon. She was unable to conceal her worry over the prospects of having her vacation violently interrupted. The speaker replied, "Madam, you have just heard how in the past when the country became well covered by forests, something broke loose, and, quicker'n a wink, down came the rocks and ashes. That's happened a dozen times. I'm superstitious about the number thirteen. Look all around you. See how nicely the trees are developed? Every time in the past when the forests got going like this, that was the sign for her to rip loose. You can see she's all set now. I look for her to pop at any moment."

The lecturer's intended humor overshot its mark, and the woman left paler than she came, departing from the Park early the following morning, undoubtedly after a sleepless night. Up to this moment, the forests are still growing nicely

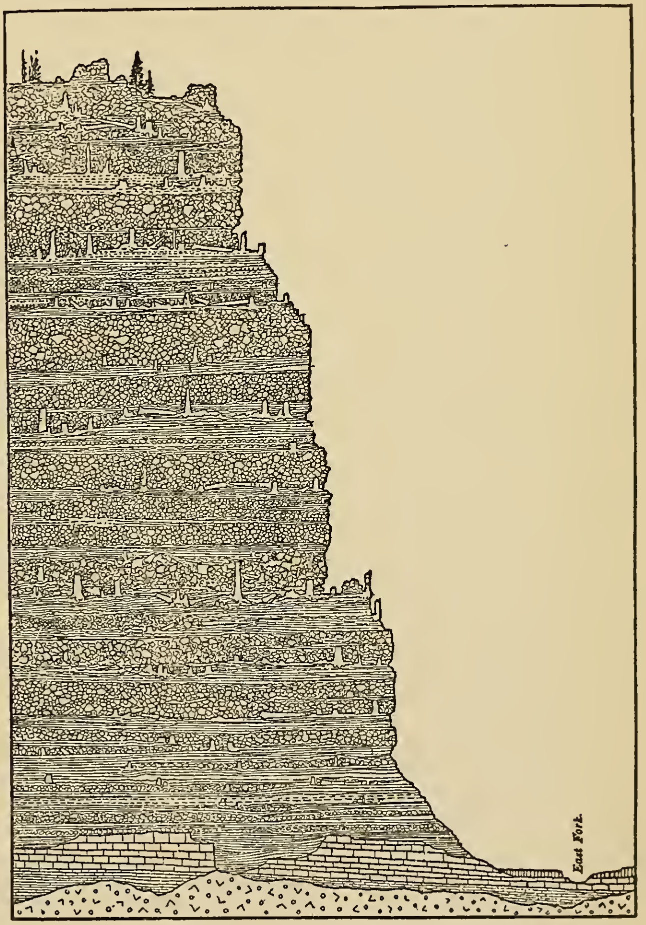
That the volcanic action was violent is indicated by the large, irregular rocks distributed throughout the finer materials forming the embedding breccia strata, as well as by the fact that no limbs or stubs have been discovered on the inundated tree trunks.

The absence of limbs might in a large measure be due to the shallowness of the strata. Many layers are only a few feet thick and would cover only the lower part of the trees where limbs are scarce. That the volcanic showers were accompanied by little, if any, heat, is thought by some to be indicated by the fact that only rarely are charred tree trunks found.

If heat were present, the portions which protruded above the layers would probably have burned. However, a heavy downpouring of débris would smother rapid oxidation of the covered trunks as is well illustrated by shoveling dirt on to a fire. The abundance of fossil leaves which show no signs of having been scorched may also indicate the absence of fire. But many delicate leaf impressions show no indication of having been battered by the falling material, either. Possibly they were engulfed in fine débris which protected them from the larger missiles, or in the mud flows which often accompanies eruptions. However, the mud flows should be equally favorable to projecting limbs.

Possibly the leaves were dropped into ponds or swamps, or covered before the eruptions occurred, in which case they would show no effects of either violence or heat. These and many other problems have not yet been definitely worked out by geologists.

One of the strangest things in connection with these fossil forests, according to Dr. Clyde Maxwell Bauer, park naturalist of Yellowstone Park, and a geologist, is the fact that no mammal remains have been found, so far as he knows. He is inclined to believe, however, that such fossils will be found upon more thorough search of the deposits.



Fossil Layers

An ideal section through 2000 feet of beds of Specimen Ridge, showing succession of buried forest, as visualized by W. H. Holmes, 1878. An actual photograph of a similar deposit that has been uncovered through a long period of weathering appears on page 389

Mammal remains are very important to the paleontologist. During the last great geological era, when these petrified forests were formed, mammals came into their own. So quickly did they change in form during their evolutionary development, that each form represents an extremely short sub-division of geological time. Therefore, the discovery of mammal fossils would definitely indicate the age of the embedding strata.

When Wood Petrifies

Just what happens when wood is petrified is explained by some scientists as being a replacement, molecule by molecule, of the wood substance in solution. Others claim that the wood is not replaced at all, that silica filters between the solid parts of the wood and is deposited around the fibers, which always remain. When two such opposing scientists get together, they go round and round, each emerging convinced that his own particular brand of orthodoxy is correct.

Two years ago the writers discovered a specimen which neither "school" could claim. It was a piece of limb about eight inches long, two and one half inches in diameter, with a well formed scar out of which a branch had grown. The entire piece was of milky agate, with laminated layers, running not in the usual concentric rings, but straight across both ends. Doctor Bauer said it was a rare specimen, and explained the laminations running across the diameter thus: After burial the entire piece of wood had disintegrated and all of the wood structure had been removed. The perfect cavity resulting had not been altered nor filled until silica-bearing waters arrived to deposit horizontal layers of agate.

Many and varied are the displays of petrified remains in these Gallatin forests. One is the stump of a petrified redwood, ten feet in diameter, with the standing trunk of a dead tree projecting from the heart of the stump, and a small limber pine growing in the petrified stump beside the dead tree — trees from three generations. This ancient giant, modern ghost, and living weakling are near the top of a mountain ridge from which they overlook many rugged miles to the tip of the Grand Teton — a landmark in early days.

Near by are twin stumps, flaring together at the ground in Siamese union, so characteristic of the redwoods now growing on the coast of California. In the breccia cliff above the twin stumps is one of the few trunks petrified in a horizontal position — an agatized log as beautifully colored as those in Arizona, but in lighter hues.

One giant stump sends into the rock foundation a partly exposed root which is larger in diameter than the trunks of the trees growing at the present time in the region. Some cross sections show perfectly preserved rings of growth. In one stump the annual rings curved irregularly around the trunk, as if tremendous pressure had caved it in unevenly from different sides without allowing it to break.

In the face of one cliff dozens of trunks stand out in bas-relief, from many different layers.

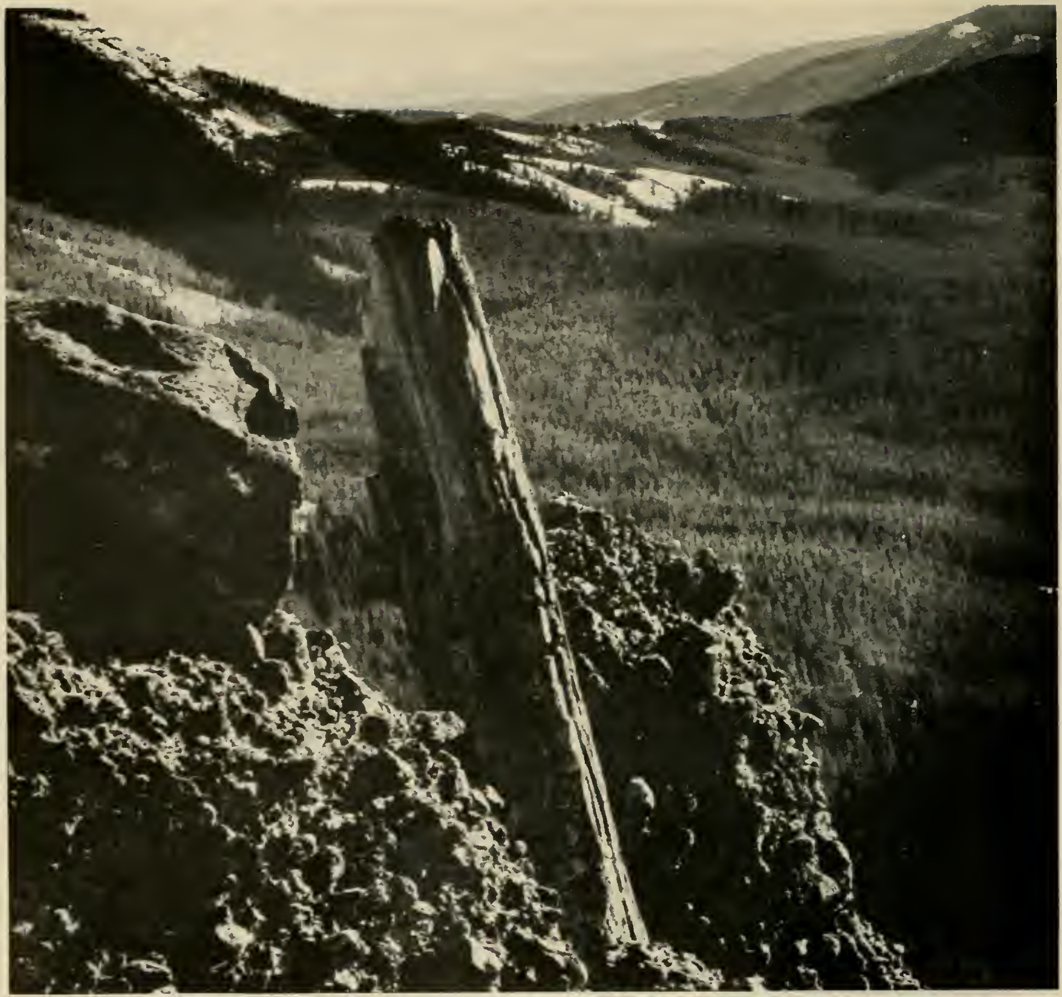
The most impressive tree of all is one discovered in the face of a projecting cliff by Dr. Paul Young of Montana State College. It stands like a pillar, as if holding up the great layer of rock which extends over as a roof. With partly exposed roots embedded in the cliff and the trunk extending up thirty or forty feet to the overhanging layer of rock, that tree appears to be defying the forces that are slowly tearing down the mountains.

Protection for Fossil Trees

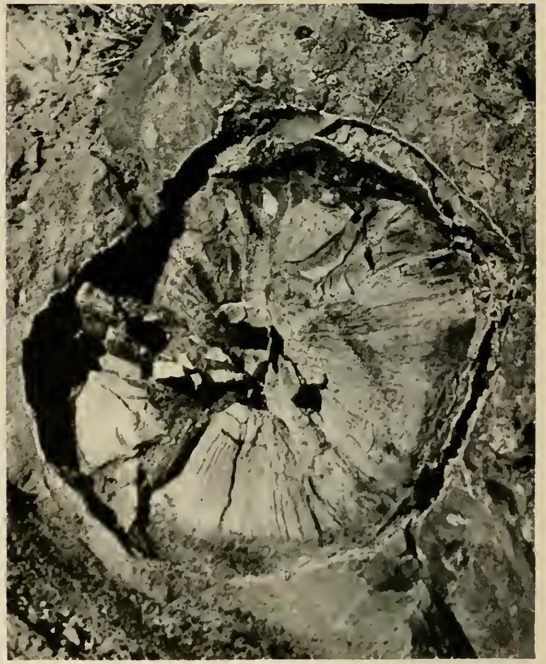
One district, however, is disheartening to the visitor who wishes to see our natural wonders preserved. Near the northern boundary of Yellowstone Park a small, well-agatized stump stands within sight of the broad pathway which hunters have worn on the line while waiting for elk. Souvenir maniacs have broken off pieces from this stump, thus reducing its diameter by a third. Near by, several other stumps had been broken off piece by piece to the roots and carried off. Fortunate it is that the records of the past are so widely scattered and inaccessible, else long ago these tablets of stone would have been broken and carried away. And unless more protection is given to the most remarkable standing petrified forests known, eventually there will be little but desecration for the visitor to see.

A TREE TRUNK FROM ANOTHER AGE

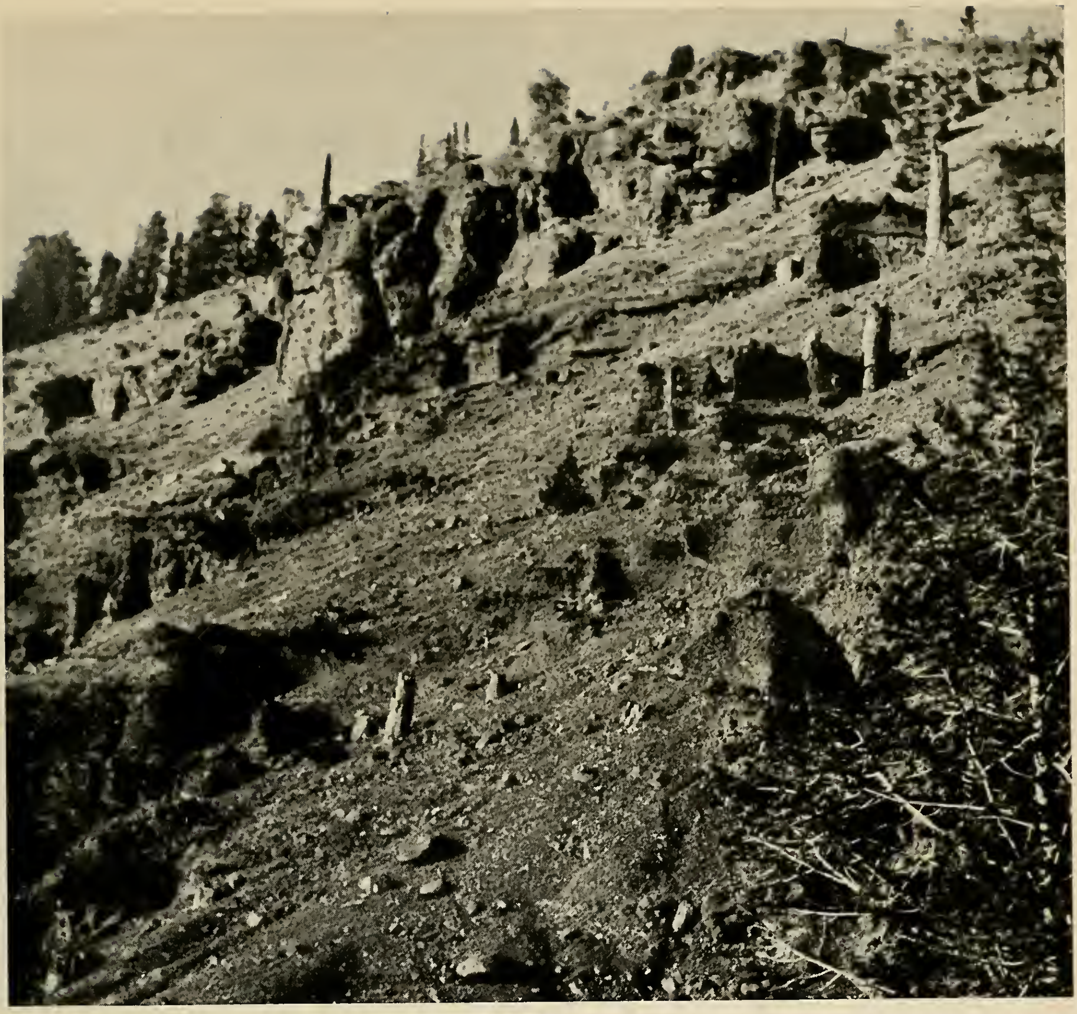
On the opposite page is shown a tree that flourished probably during the Miocene. Its life-span may still be estimated today by its rings of annual growth, which show plainly



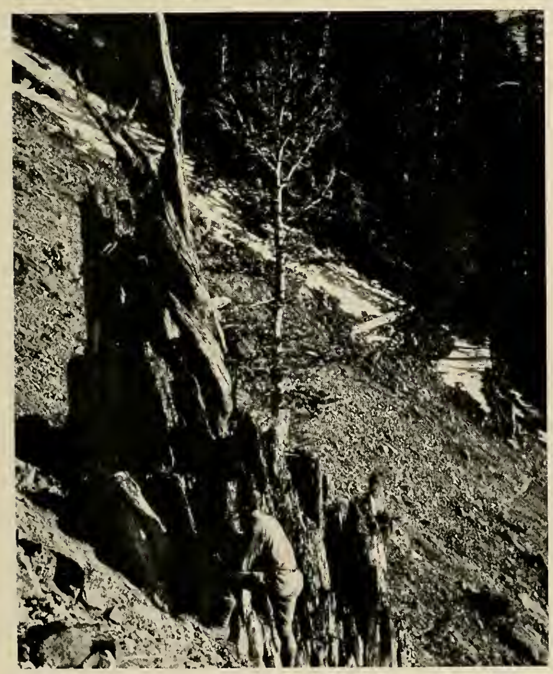
Above: A skeleton fossil tree in the Gallatin Mountain Range, which extends within and beyond the northern boundary of Yellowstone Park. The Grand Tetons may be seen along the distant sky line. The corner of the Park in which the fossil forest lies has been opened by highway only recently



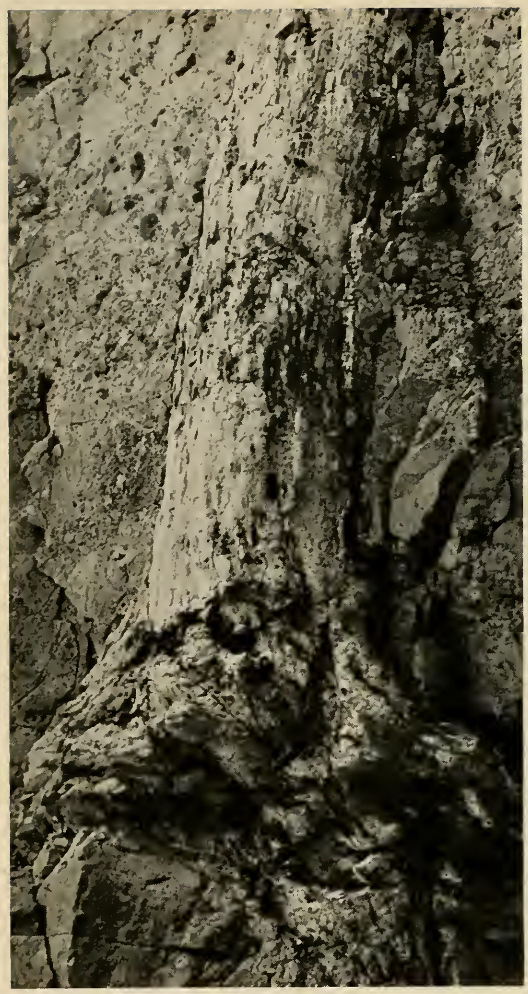
Right: An agatized cross section of a fossil stump. The stumps that have been preserved from past ages vary in diameter from three to twelve feet, dwarfing the trees now growing near them, which seldom attain a diameter of three feet

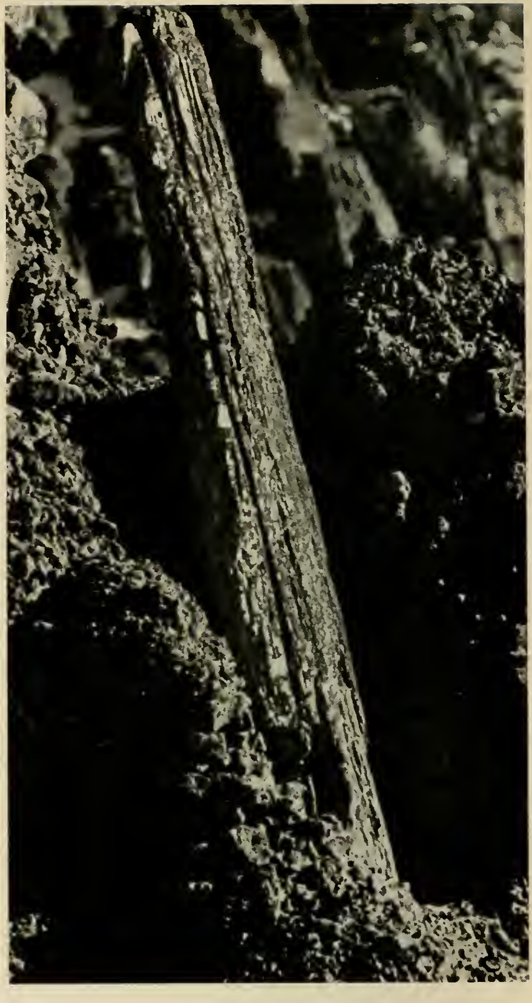


A few miles from the widely known and easily accessible phenomena of Yellowstone Park lie remarkable and little known exposures of fossil tree stumps which were petrified in an upright position. In the photograph above at least eight different layers of petrified trunks are visible



Trees from three generations: the stump of a petrified redwood, ten feet in diameter, with the standing trunk of a dead tree projecting from the heart of the stump, and a small limber pine growing in the petrified stump beside the dead tree

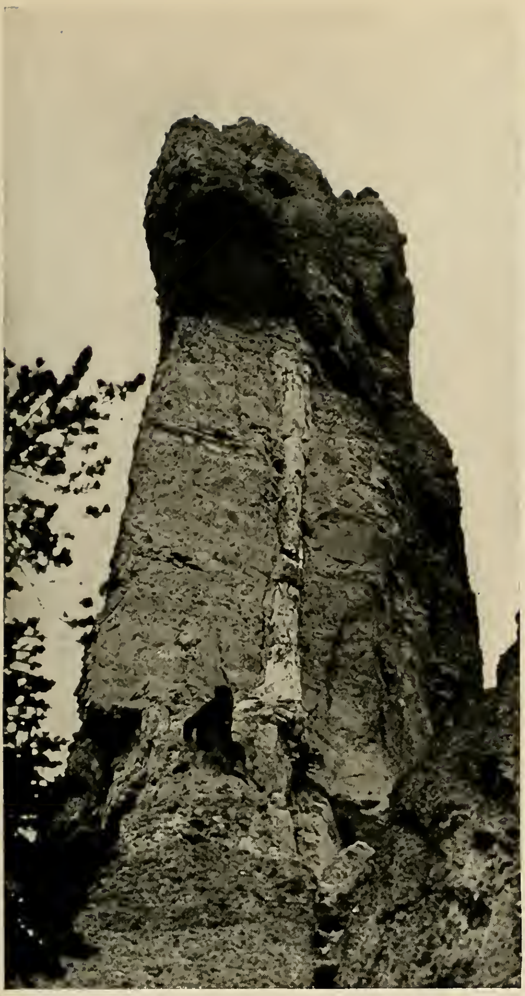


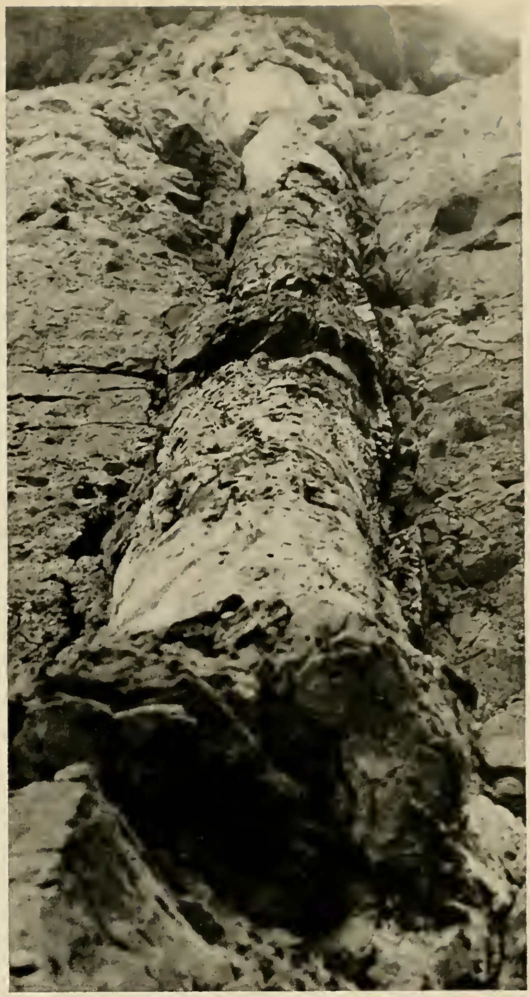


Tree Trunks

According to some scientists this petrifaction has been caused by the replacement, molecule by molecule, of the wood substance in solution. Another theory is that the wood is not replaced at all, but that silica in solution filters between the solid parts of the wood and is deposited around the fibers which always remain

A tree trunk with typical embedding débris from the ancient volcanic showers of rocks and ash which in past ages brought ruin to a thriving forest. Rarely are charred tree trunks found, indicating that little, if any, heat accompanied these volcanic showers. If heat had been present, the portions protruding above the layers would have burned

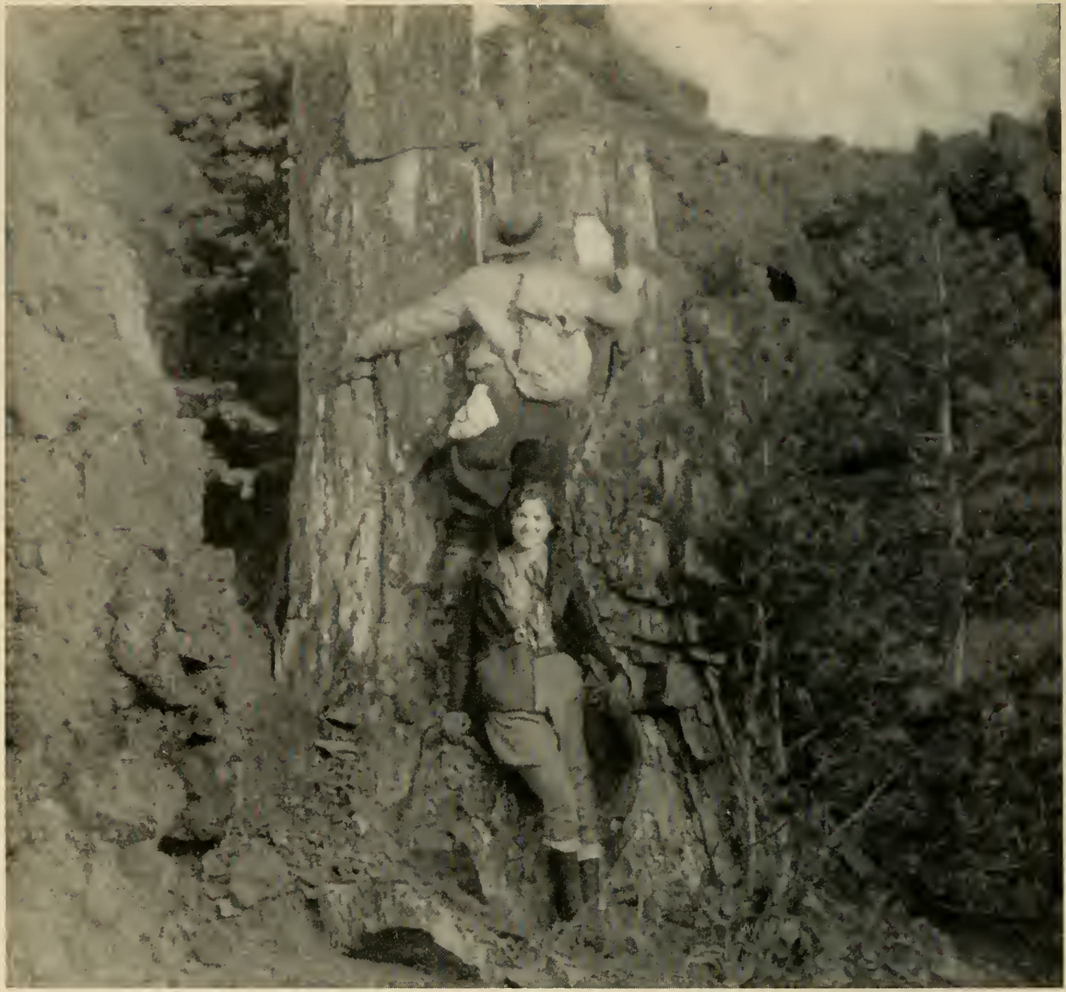




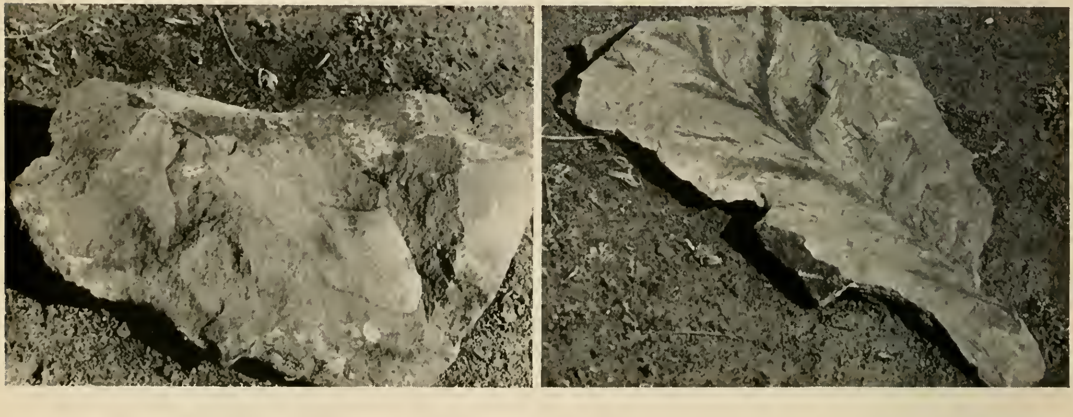
# of Stone

A pillar of the mountains which was discovered by Dr. Paul Young of Montana State College. It is one of the most dramatic sights of the whole stone forest, and might well be considered a monument to all the mighty trees that once flourished there. The overhanging strata plainly shows why the trunk is no taller

A close-up view of the tree trunk shown in the illustration at the left, photographed from the base of the cliff in which its partly exposed roots are buried. The trunk is about thirty feet high, and about a quarter of its diameter stands out in bas-relief. These large trunks suggest a very different vegetation in ages past from that of today



Above is shown the partly exposed root of a redwood stump seven feet in diameter. The root alone has a greater diameter than the trunks of the trees growing in the region at present. Below are two examples of fossil leaves, or leaf impressions, from the ancient forests. Such well-preserved specimens are to be found in abundance. *Opposite page:* a view of *Sequoia sempervirens* (the same species that once flourished in the "petrified forest") as they grow today in the Sequoia National Park, Garfield Grove, California



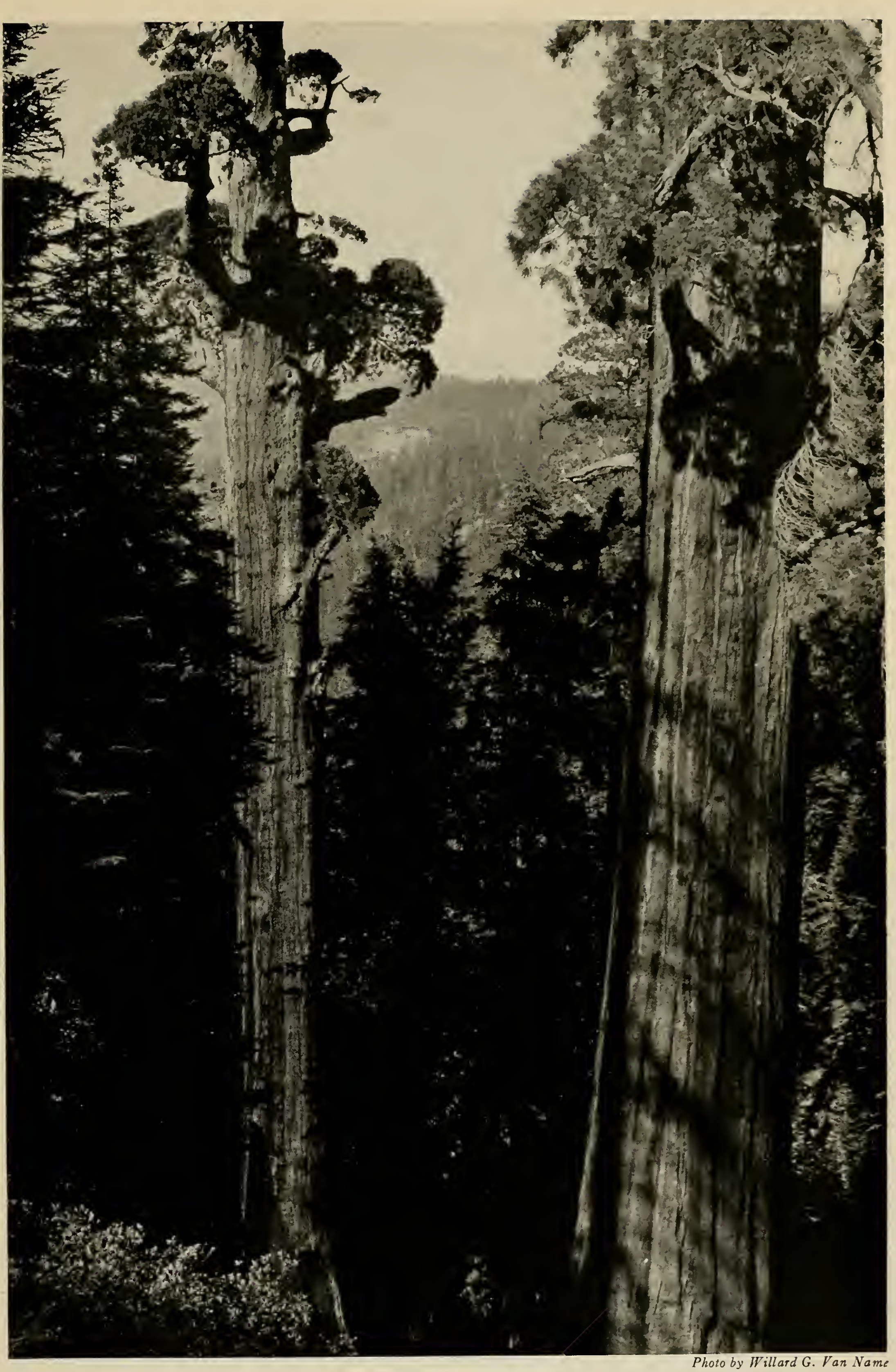
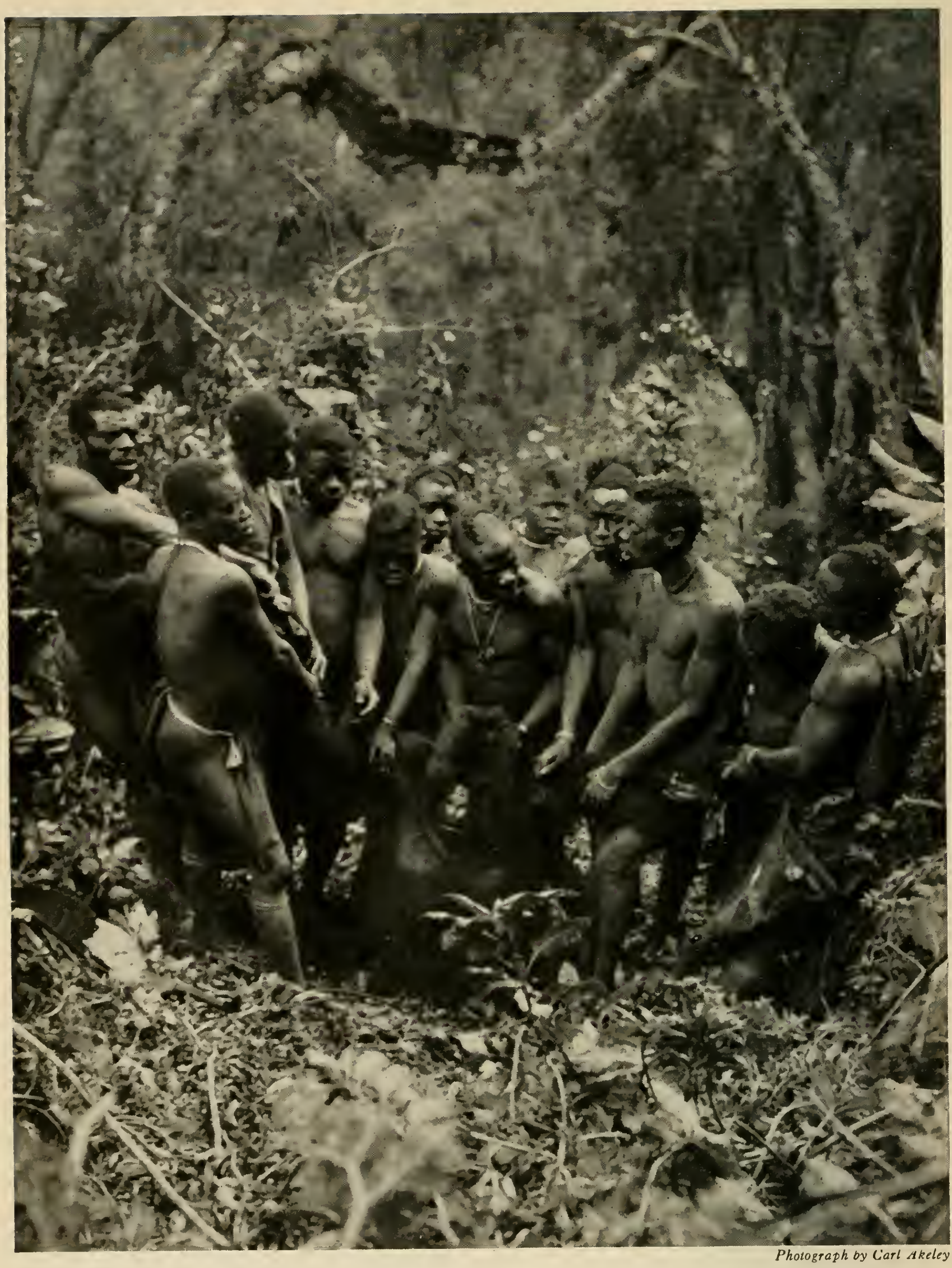


Photo by Willard G. Van Name



Photograph by Carl Akeley

COLLECTING THE GREAT GIANT OF KARISIMBI

The 400-pound gorilla, dominating Carl Akeley's gorilla group in the American Museum of Natural History. The background of the group was painted at this point

Conservation Expands in Africa

Carl Akeley's dream of absolute sanctuary for the vanishing wildlife of Africa is being realized.

By MARY L. JOBE AKELEY

Secretary of the American Committee of Institut des Parcs Nationaux du Congo Belge

WHEN Carl Akeley secured his group of mountain gorillas (*Gorilla gorilla beringei*) in the Kivu District, Belgian Congo, for the American Museum of Natural History, 1921–22, he found the great apes occupying a region of surpassing wildness and beauty, unfit for agriculture and other human uses except to supply bamboo and firewood.

He believed this high mountainous area, rising abruptly from the plains below and containing all the zones of climate of the earth, ideal for a gorilla reserve and a biological survey station. Accordingly, in 1923, he prepared a plan of absolute sanctuary and submitted it to Dr. John C. Merriam of the Carnegie Institution, Washington, dean of conservationists and promoter of scientific research. "*Sanctuary is not sanctuary unless absolute*," said Akeley.

Doctor Merriam immediately recommended this plan to the then Belgian Ambassador, the Baron de Cartier de Marchienne, and with it submitted a statement covering the organization, history, and method of establishing the national parks of America. In 1924, Ambassador de Cartier began active efforts with the Belgian Government to the end that a Congo national park should be established — the first in all the great continent of Africa. Seconding the efforts of the Baron was the Belgian Consul General of Baltimore, The Honorable James Gustavus Whiteley, for whose unfailing assistance all American Museum scientific expeditions to the Congo owe a great debt. Finally, in 1925, His Majesty, Albert, King of the Belgians, created the Parc National Albert, in the area including Mounts Mikeno, Karisimbi, and Bishoki, for absolute protection of gorillas as well as all other wild life — plant and animal.

From the beginning President Henry Fairfield Osborn had been in sympathy with the idea of gorilla protection. In 1927 Professor Osborn and the Trustees of the American Museum of Natural History endorsed the project of scientific research in the new park. In 1929 King Albert created the Parc National Albert as a *corporate body* in the Belgian Congo and in the mandated territory of Ruanda-Urundi for *strictly scientific purposes*. Since then the Parc has been administered by the Commission du Parc National Albert, an international body, and by a Committee of Direction. Professor Osborn and Doctor Merriam are members of the Commission.

The original gorilla sanctuary was ten miles square with an outlined protecting zone. After the survey conducted by the Akeley-Derscheid Expedition to the Kivu in 1926–27, the original area was increased from 24,000 hectares to 200,000 hectares, approximately 500,000 acres. Subsequent to 1929 Dr. J. M. Derscheid, then Director of the Parc National Albert, made two long and outstanding surveys of the new park and of other important areas to the end that other parks be established for the protection of such rare species as white rhino and okapi and the preservation of the beautiful Ruwenzori Mountains. On one of these important surveys, covering in most minute detail a vast extent of territory from Southern Ruanda-Urundi to the Southern Sudan, was Prince Eugene De Ligne. He had rendered invaluable service to the conservation project at the time the park was organized, was then President of the Commission du Parc National Albert, and is now Counselor of the Belgian Embassy in Washington.

In 1931 His Royal Highness the Duke of Brabant became President of the Commission. His extensive explorations of the Parc regions and his devotion to science are recognized in every land. With his elevation to the throne, he was succeeded as president by the distinguished scientist, Dr. Victor Van Straelen, Director of the Royal Museum of

Natural History, Brussels. Since 1925 rapid progress has been made in park affairs.

With a view to coördinating the management of the present and future scientific reserves and national parks in the Belgian Congo, His Majesty Leopold III, by Royal Decree dated November, 1934, created the Institute of National Parks of the Belgian Congo (Institut des Parcs Nationaux du Congo Belge).

This new body replaces the Commission du Parc National Albert and takes over the control of both the Parc National Albert and the new Parc National de la Kagera created in November, 1934 which lies in the mandated territory of Ruanda-Urundi.

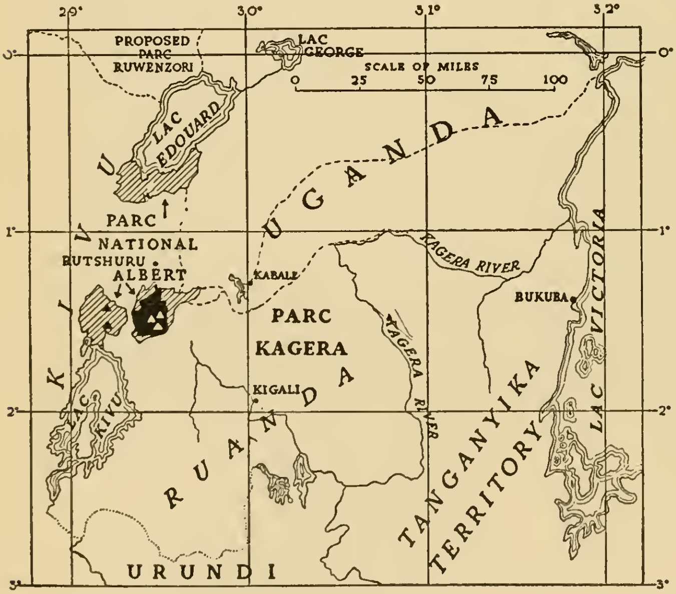
The members of the former Commission of the Parc National Albert are designated, by the Royal Decree, as members of the first Commission de l'Institut des Parcs Nationaux du Congo Belge, and the membership has been enlarged from 18 to 24. Their term of office, with the exception of the president and secretary, is limited to six years, and retiring members are not eligible for reappointment until after the expiration of three years.

Doctor Van Straelen has been made president of the new Institute. Professor Osborn and Doctor Merriam are members.

The Parc National Albert has been enlarged, and its outlines revised so as to exclude certain districts open to colonization or where the presence of natives would conflict with the purposes of the Park. The Park now includes 950,000 acres; the Parc de la Kagera 650,000 acres. In accordance with a suggestion made by His Majesty King Leopold III prior to his accession to the throne, application has been made to the government for the creation of another Park of 1,000,000 acres, west and north of Lake Edward, including the valley of the Semliki River and extending to the Ruwenzori.

Since certain portions of the area now occupied by the Parks are not especially useful for scientific purposes, the Institute will organize tourism in those sections and fix rates for permission to enter. During the year 1934, 166 persons entered the Parc National Albert, of whom 42 visited the volcanoes Nyiragongo, Nyamlagira, and Rumoka; 8 visited Mt. Mikeno; and 66 visited Lake Edward.

By the liberality of a few Belgians interested in the Congo Parks, an organization has been formed under the name of the "Fondation pour favoriser l'Etude scientifique des Parc Nationaux du Congo Belge" for the purpose of aiding scientific expeditions. The present annual revenue from this fund is 250,000 Belgian francs or approximately $10,000.



This map shows the three sectors of the Parc National Albert, the newly created Parc Kagera and the proposed Parc Ruwenzori. The area in black is the original Gorilla Sanctuary proposed by Carl Akeley. The small black triangles indicate the active volcanoes Nyamlagira and Nyiragongo. The white triangles show the location of the three extinct volcanoes Mikeno, Karisimbi, and Bishoke.

Fortune and Misfortune in Antarctica

Adventures and discoveries of the 1934–35 Ellsworth Expedition to Graham Land

By Lincoln Ellsworth
Trustee of the American Museum

THERE are so many interesting facts about the great unknown continent of Antarctica that few people realize their significance and volume by merely looking at a map of this great polar region. To start with, Antarctica is quite a sizable place. In fact, it is 5,000,000 square miles in area — or as large as Europe and Australia put together.

In contrast to the North Pole, which is an ocean surrounded by continents, Antarctica is a continent completely surrounded by water. One of the interesting features of the Antarctic is that the South Polar Plateau lies 10,000 feet above sea level while the North Polar region lies 10,000 feet below sea level. By that I mean that the ocean at the North Pole is from 10,000 to 12,000 feet deep. I speak from personal observation, for in 1925, when Amundsen and I were forced down 120 miles from the Pole, we took two soundings and found depths of 12,000 feet.

Asia has been called the "Roof of the World," yet Antarctica is on the average twice as high as Asia and seven times as high as Europe. This vast continent, locked in the grip of everlasting winter and covered with an ice cap which is estimated to be more than a mile and a half in thickness, is 90 per cent unexplored.

The 1933 Expedition

The base of my first Antarctic expedition was the Bay of Whales in the Ross Sea. I planned to fly the 1450 miles from there to the Weddell Sea, because I wanted to learn, if possible, if these two great seas meet and thus divide Antarctica into two parts. Another problem that interested me was whether the highlands of Graham Land, which are considered to be a continuation of the Andes of South America, continue on across Antarctica to join the mountains of Victoria Land. It is possible that the Queen Maud Range is a part of these mountains.

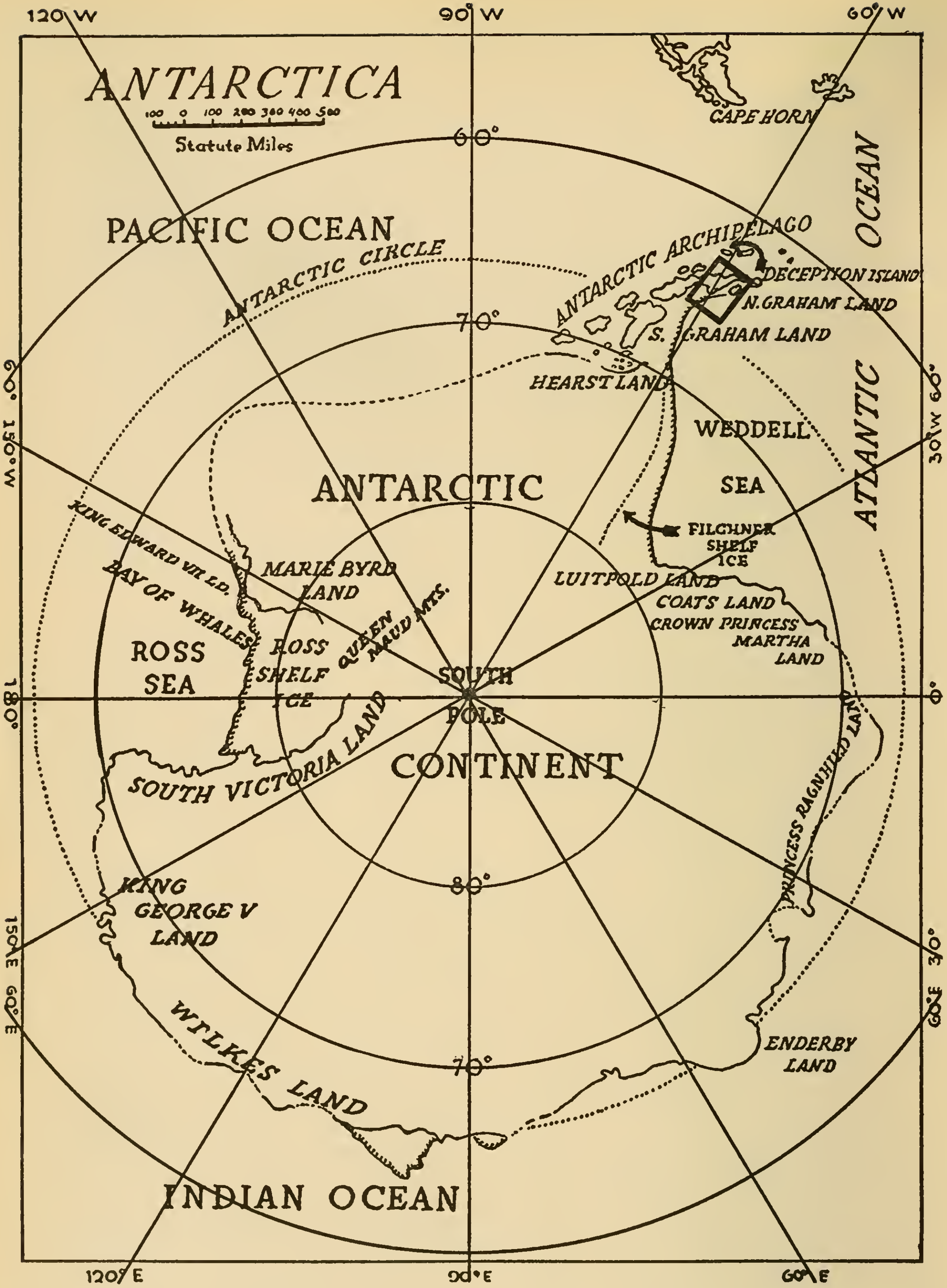
We sailed south from New Zealand December 10, 1933, aboard the "Wyatt Earp," but were held up by the great pack ice leading to the Ross Sea until near the middle of January. That made it too late for a season's exploration journey such as I had planned. So this year I decided to reverse my program and fly from the Weddell to the Ross Sea, selecting Deception Island as my base. This remote and uninhabited island lies just 600 miles south of Cape Horn and is separated from South America by the stormiest ocean in the world.

Deception Island, 1934

After an uneventful voyage of 5000 miles across the lonely, storm-swept South Pacific from New Zealand, where the ship had wintered after her return from the Ross Sea, we arrived at our new base in Deception Harbor on October 14, 1934. We had been looking forward to finding decent spring weather there, but instead, winter conditions with gales and snow squalls still prevailed.

Deception Island is bare and desolate except for the buildings of an abandoned Norwegian whaling station that has not been used since 1930. It is a known fact that about 100,000 whales have been killed in Antarctic waters during the past twenty-five years, and there are thousands of whale bones in this harbor, with the result that the stench at low tide is terrible. Besides being the graveyard of whales it is also the graveyard of whalers. A tall monument was erected on the island in memory of the crew of an entire ship that was crushed in the Weddell sea pack and went down with all hands aboard.

It was a week before we could get the "Wyatt Earp" through the ice-cluttered harbor and up to the dock to unload the plane. The "Wyatt Earp" is a fine little exploring ship. I named her after the great frontier marshal of Tombstone and Dodge City. He was the most efficient peace officer


ANTARCTICA
100 0 100 200 300 400 500
Statute Miles
120° W
90° W
60° W
CAPE HORN
60°
70°
80°
PACIFIC OCEAN
ANTARCTIC CIRCLE
ANTARCTIC ARCHIPELAGO
DECEPTION ISLAND
N. GRAHAM LAND
S. GRAHAM LAND
HEARST LAND
OCEAN
ATLANTIC
WEDDELL
SEA
FILCHNER
SHELF
ICE
LUITPOLD LAND
COATS LAND
CROWN PRINCESS
MARTHA
LAND
ANTARCTIC
KING EDWARD VII LD.
BAY OF WHALES
MARIE BYRD
LAND
QUEEN MAUD MTS.
ROSS
SEA
ROSS
SHELF
ICE
SOUTH
POLE
SOUTH VICTORIA LAND
CONTINENT
PRINCESS RAGNHILD LAND
KING
GEORGE V
LAND
WILKES LAND
ENDERBY
LAND
INDIAN OCEAN
150° W
30° W
180°
0°
150° E
30° E
60° E
120° E
90° E
60° E

THE ELLSWORTH 1934–35 EXPEDITION

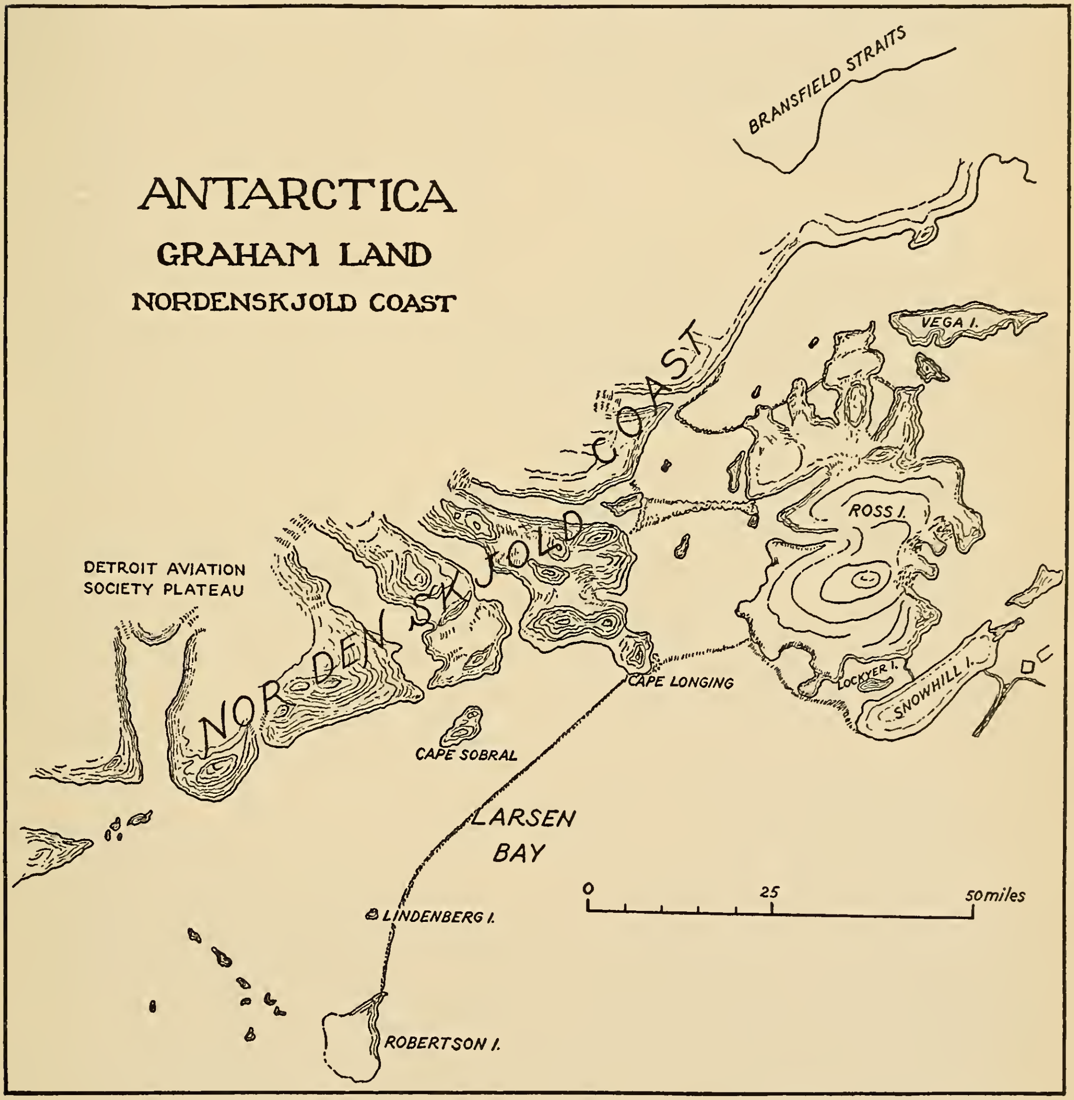
The small square at the upper right represents the scene of Lincoln Ellsworth's exploratory work. The flight added five islands, three deep fjords, and several conspicuous mountain peaks to the sum of human knowledge about the Antarctic; a more detailed map of these discoveries appears on page 399 and the greatest gun-fighter the West ever knew. It is an odd coincidence that I named my ship after him before I learned that Wyatt Earp held his first frontier job in Ellsworth, Kansas.

We spent a week unloading the plane and another week assembling it. Again luck was against us, for no sooner had the motor been started than a connecting rod between the piston and the crankshaft broke. An extra connecting rod was not to be found, for it proved to be the sole item not included among the extra parts we took with us.

Merely because a little strip of steel was forgotten, our boat had to make a voyage of 1800 miles to South America and back in order to replace this part. The "Wyatt Earp" made the round trip in sixteen days, due to the exceptionally favorable weather, which completed 28,000 miles of voyaging for her since leaving Norway, July 29, 1933. All these miles in quest of a twenty-hour flight!

While the boat was gone, we assembled the emergency supplies to be carried on the flight in case of a forced landing. A hand sledge was loaded with emergency rations sufficient to last two men two months. The load weighed just 500 pounds.

Among the delicacies we dined upon during


ANTARCTICA
GRAHAM LAND
NORDENSKJOLD COAST
BRANSFIELD STRAITS
VEGA I.
ROSS I.
DETROIT AVIATION SOCIETY PLATEAU
NORDENSKJOLD COAST
CAPE LONGING
LOCKYER I.
SNOWHILL I.
CAPE SOBRAL
LARSEN BAY
LINDENBERG I.
ROBERTSON I.
0
25
50 miles

REGION OF EXPLORATION

The territory left of Cape Longing was discovered by Lincoln Ellsworth on his flight of January 3, 1935, in the "Polar Star." Because of adverse weather conditions, Ellsworth and Bernt Balchen, the pilot of the expedition, were forced to wait five weeks before this flight could be made our stay on Deception Island were penguins and their eggs. There are thousands of penguins on the island, in fact, it is one great rookery. Penguins are funny, fearless, and friendly fellows. They stand with their eggs between their feet and hatch them that way because they do not build any nests.

On learning that the penguins would put up a fight if we tried to take their eggs away without giving them something in return, we really developed quite a technique at egg-snatching. We would go up to a penguin and, while gathering the egg with one hand, would shove a hat under the bird with the other; then quickly pull the hat away again. A penguin egg is about the size of a duck egg and is good eating when fried or made into an omelette. But steer clear of a boiled penguin egg!! It has the consistency of rubber and tastes like strong fish.

Delay

Our delays at Deception Island were costly. Day by day the snow melted, and with miserable weather prevailing — anything but flying weather — we abandoned all hope of a take-off. So, with the assembled plane loaded on deck, we lifted anchor on November 28 and headed south for regions more favorable, or so we thought.

We traveled 150 miles south along the west coast of Graham Land and tried to reach Port Lockroy but could not get there because of the ice pack. We set a northward course, passed through Antarctic Sound, and as the ocean in that neighborhood this year — early in the season — was remarkably free from ice, we were able to go into the Weddell Sea and go as far south as Snow Hill Island.

Snow Hill Island is one of the most interesting spots in Antarctica — a small dot in that vast region of ice and snow — made famous by the expedition of the great Swedish explorer, Nordenskjöld. One of our most dramatic moments on Snow Hill Island was finding Nordenskjöld's hut thirty-three years after he wintered there in 1902 and 1903.

Nordenskjöld's ship, returning to pick him up after his first winter there, was crushed in the ice. This meant that he and his party of five had to spend a second winter in the Antarctic. We could reconstruct the helter-skelter scene as the men made a mad rush to reach the rescue ship, an Argentinean gunboat, that reached them just in time to effect their rescue before the ice shut them in for the third winter.

Three dogs lay just where they had been shot thirty-three years ago. Their bodies were mummified and still covered with white hair. Hats lay where they were dropped — a pair of boot-trees were there, and the most amusing thing was a pair of ice skates. Unopened sardine cans and packages of chocolate also lay about. We didn't bother with the sardines, but the chocolate was still good. We also found an old-fashioned phonograph and a dozen wax records — but even in Antarctica the tunes were terrible.

The hut itself was a bare little dwelling, gyved on the four corners with steel cables. This was done to keep the hut from being blown away. A sound precaution, for in his book, Nordenskjöld speaks of ninety-mile gales that roared for weeks at a time.

When we looked through one of the small windows into the hut, we were amazed to see nothing at first but a huge block of blue ice that almost filled the interior. How that ice came to be there we never could discover. A large timepiece hung on the wall and the hands pointed to three o'clock. We took it down, set it going, and it ticks away now, just as it did thirty-three years ago.

The Nordenskjöld Fossils

The purpose of Nordenskjöld's expedition was to search for fossils on Snow Hill Island and plenty were discovered. We, too, found quite a few fossils and they tell a strange story, — that Antarctica once had a subtropical climate. The waters were warm, the land was green, and both land and water teemed with life. Mighty trees covered the land — but that was 75,000,000 years ago.

In all, we brought back about 200 fossils. They included about 50 species of shell fish and several pieces of petrified wood. These specimens were turned over to the American Museum of Natural History to be studied by Dr. Chester A. Reeds, curator of invertebrate palæontology.

The thing that astounded me most in finding these fossils was that they were of creatures which showed signs of having been fat and well-nourished. Naturally I asked myself the question, "What sudden catastrophe could have overtaken this land, rich in animal and plant life?" So far, I have not found the answer.

Of course, our hunt for fossils did not start until after we moored the "Wyatt Earp" to the front of the glacier which runs to the very edge of the island, unloaded the plane, taxied it up to the plateau above, a mile and a half inland and 600 feet above sea level. There we found the snow firm and suitable for our take-off.

Next, all hands manned the sleds and hauled two tons of gasoline and oil up the steep slopes. It was a hot and back-breaking job, for although the Antarctic summer at sea level hangs about ten degrees below the freezing point, the sun's reflection on the snow throws off quite a little heat.

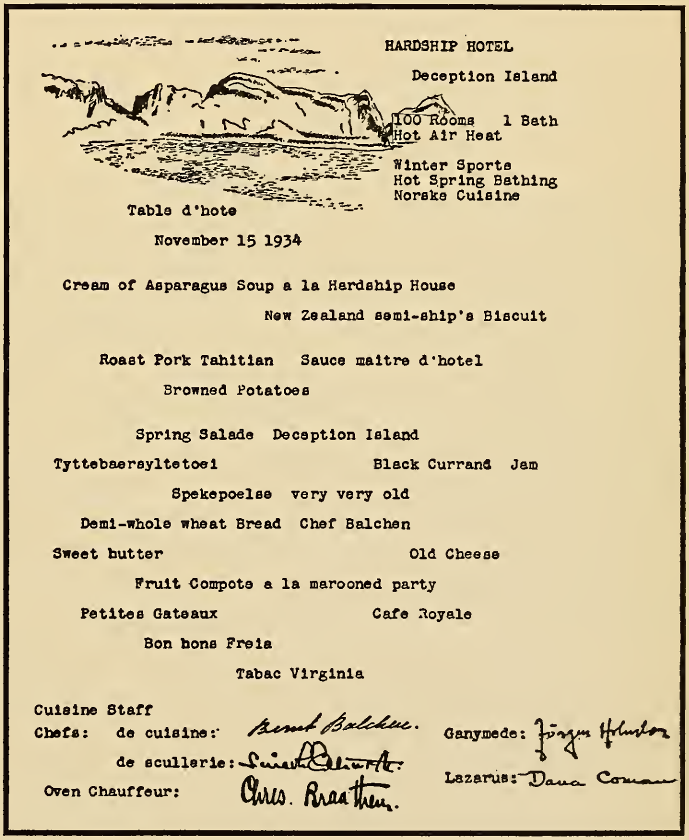
We put up a tent close to the plane in which four of us planned to live in order to carry on with the flight if it became a question of the boat having to leave on account of menacing ice conditions. We made a few test flights and were all set to take off but could not leave because the weather became almost unbearable. To add to our troubles, the ice front commenced to break off and the "Wyatt Earp" was forced to move out to safe anchorage.

For ten days a gale ranging from twenty-five to fifty miles an hour blew, accompanied by snow, so that all we could do was to stay aboard and gaze longingly southward upon the ice-studded expanse of the Weddell Sea for just one break to get into the air. Our very existence became a game of "patience" — our only weapon against the unpredictable and uncontrollable forces of nature and the elements.

The only visitor we had in the Weddell Sea was an emperor penguin. This bird is one of the most remarkable animals living. Among other things, it lays its single egg in the dead of winter so that the young will be large enough to take care of itself the following winter. Both fathers and mothers fight to take care of the young, and the poor infants are so mauled with love that they frequently seek shelter in the crevasses of the surrounding rock to escape destruction. The mortality rate must be very high, because young penguins are often found frozen to death in these refuges — victims of parental love.

Misfortune

Finally, on January 3, 1935 — after five weeks of weary waiting — our chance came. But we lost it because it took us a long time to get the "Polar Star" with its total load of 6698 pounds into the air. The new snow, which had fallen on January 1, had drifted into low *sastrugi* in patches on the glazed surface of Snow Hill Island Barrier, and they acted as would a series of morasses on a regular landing field. Each one slowed up the speed of the plane with a marked tendency to turn the machine over on its nose. Time and time again, Balchen brought the airplane



HARDSHIP HOTEL

Deception Island

100 Rooms 1 Bath
Hot Air Heat

Winter Sports
Hot Spring Bathing
Norske Cuisine

Table d'hote

November 15 1934

Cream of Asparagus Soup a la Hardship House

New Zealand semi-ship's Biscuit

Roast Pork Tahitian Sauce maitre d'hotel

Browned Potatoes

Spring Salade Deception Island

Tyttebaersyltetoei Black Currand Jam

Spekepoelse very very old

Demi-whole wheat Bread Chef Balchen

Sweet butter Old Cheese

Fruit Compote a la marooned party

Petites Gateaux Cafe Royale

Bon bons Freia

Tabac Virginia

Cuisine Staff
Chefs: de cuisine: Bernt Balchen. Ganymede: Jörgen Holmboe
de scullerie:
Oven Chauffeur: Chris. Braathen. Lazarus: Dana Coman

A Banquet at the Antarctic

A decorative menu evolved by the commissary department of the Expedition into the wind which was blowing down the slope of the best take-off area, but we could not get off on the up-grade.

Once Balchen turned his head and yelled: "Look out! I think we will turn over." I made sure my safety belt was tight and braced myself, but — nothing happened.

Discoveries

After almost an hour of taxiing, Balchen turned to a dangerous downhill slope on the southern side of the island and in a side wind opened up the 525 H.P. Wasp motor. With our movable pitch propeller set at the most advantageous angle, we finally got clear of the sticky surface. A little earlier in the afternoon the prospects had seemed excellent, but when we reached an altitude of 3000 feet, we saw a snow squall to the south. It blocked our path as effectively as if it had been a stone wall. The only thing to do was to go as far as possible and to do as much new work as opportunity would allow. Hence, after circling the "Wyatt Earp," we crossed Snow Hill Island, Lockyer Island, and flew over the glacier-fringed southern end of Ross Island to Cape Longing. Then we skirted Sobral Island, passed over Lindenberg Island, and between Robertson Island and Seal Nunataks. Here the clouds closed in above us and light conditions were extremely bad. In a few minutes we could see more squalls descending and we turned southwestward to follow the edge of the storm.

Without going into protracted details about the flight, let me say that it added five islands, three deep fjords, and several conspicuous mountain peaks to the sum of human knowledge about the Antarctic.

The ice-encrusted Antarctic seems vast and vague to those who have not seen it. But until you fly a mile above its surface, thereby extending actual vision of conditions across a diameter of several hundred miles, it is impossible to comprehend the vastness, the might, and the seeming unconquerableness by puny man of this ice-bound world over which we soared on man-made wings.

After our flight, which lasted two hours and a half, we stayed on the island as long as we dared, hoping for another chance. But it never came. In a few days, the ice began to come in — huge icebergs that drifted toward us in ghostly silence and soon covered the surface of the sea.

On the 10th of January we knew that our time was up if we were to get back home, and on the 13th, we pulled the anchor up and tried to get out. Our attempt was unsuccessful. After journeying sixty miles, we were turned back to Snow Hill Island by heavy pack ice. The next day we tried again. The sea was covered with solid ice floes that measured many miles in each direction, but Providence was with us. That day we got as far as Vega Island, a matter of about 100 miles. At Vega Island the ice closed in on us again. We could not go ahead. We could not turn back. We were caught and we were almost done for. After talking the situation over, we agreed that the best thing to do was to prepare to abandon ship. We all worked furiously throughout the night, checking emergency rations and preparing packs with which to struggle over the ice or drift on a floe to open water where, with our life boats with us, we could take to the sea.

We were ready to abandon ship, but about four o'clock in the morning the wind changed. Instead of sweeping ice down upon us, it swept it away. That was a change in our favor. We knew that to go on was courting trouble, but realized it was a risk we had to take. Mile by mile we worked our way northward, and, at last, after a trip that seemed like centuries, but lasted only a day and a night, we got out of the treacherous Weddell Sea into the clear waters of the South Pacific.

Lure of the Unknown

In retrospect, our recent exploration stirs us with mingled feelings. I suppose it is only natural that our satisfaction over the safe accomplishment of a difficult thrust into the borders of the largest unknown area on the face of the globe should be tinged with the inquietude of curiosity not fully satisfied. It is this unresting curiosity that has always driven explorers toward the complete discovery of every land and every sea, and toward the full utilization of the resources which are man's heritage on this planet. There is satisfaction, to be sure, in having added the results of this expedition to the sum total of knowledge. And perhaps I should be content in having taken part in five polar expeditions. Yet the lure of the unknown still beckons.

Penguin eggs were one of the Expedition's food staples on Deception Island. Boiled penguin eggs taste fishy, but scrambled or made into an omlette they provide a pleasant change in the diet

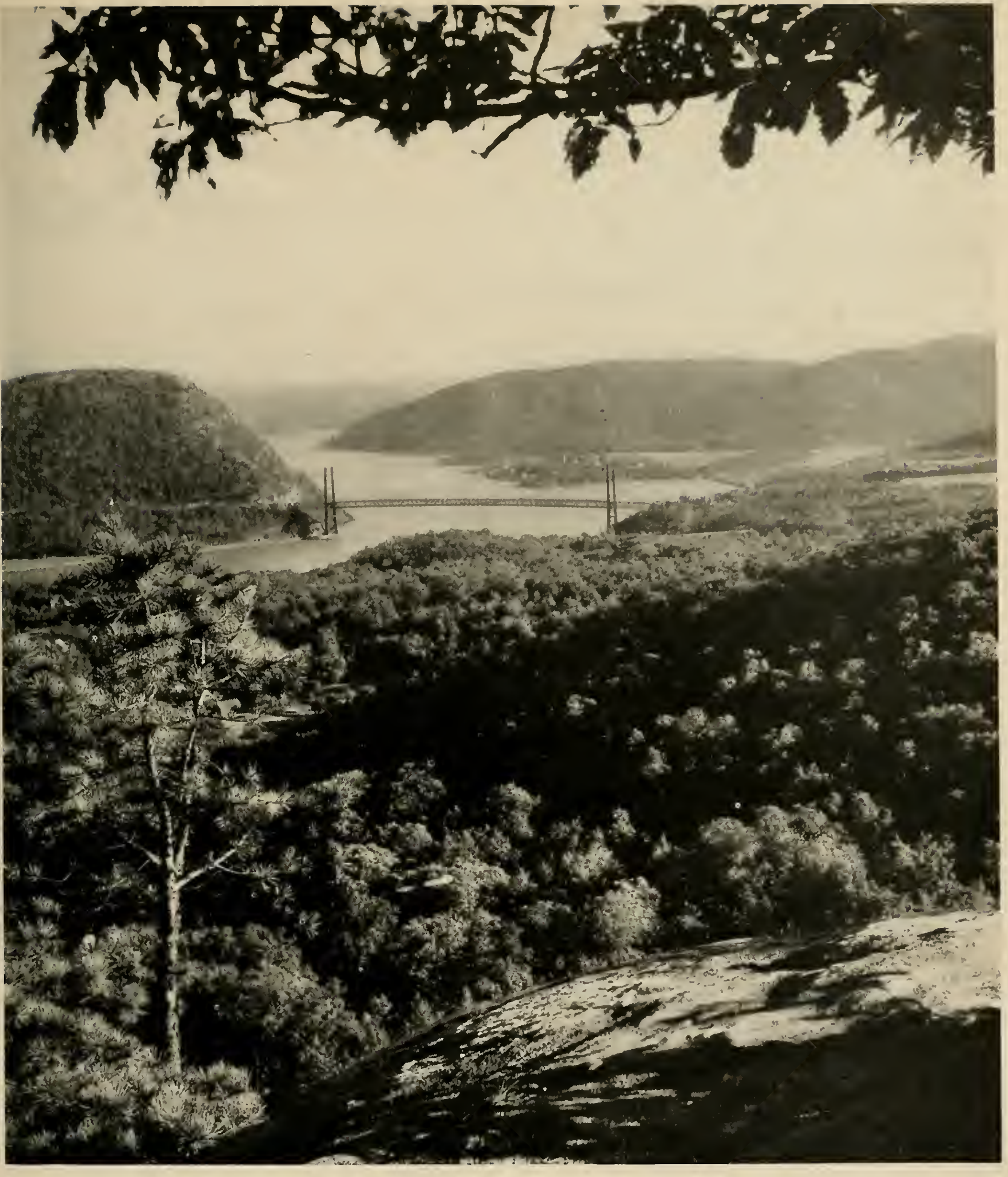
Below: Making a test run on Deception Island. It was shortly after this test was made that the connecting-rod broke, which necessitated a long journey to South America for a strip of steel that weighed less than five pounds

Unloading the "Polar Star" on the shelf ice at Snow Hill Island

Dragging the supplies up the steep slope from the sea was a gruelling grind

The breaking of this small piece of steel prevented the take-off from Deception Island. *Below:* The "Polar Star" waited week after week to rise into the air

Blizzard after blizzard kept the party grounded; between blizzards the men were busy digging out the plane. *Below:* The snow shelf turned into a frozen Niagara



Wild Animals of the Hudson Highlands

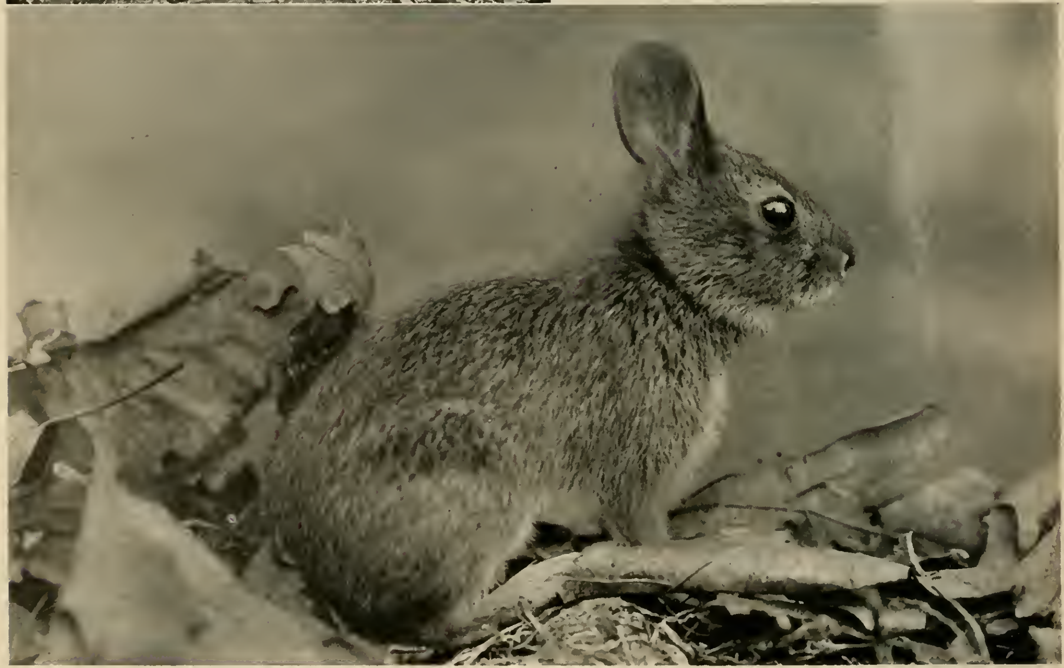
Millions of persons visit the Hudson Highlands each year. By far the great majority come to the Bear Mountain — Harriman Section of the Palisades Interstate Park, pictured above. Here the majestic Hudson flows through a narrow gorge between gracefully rounded mountains. The slender iron strand of the Bear Mountain Bridge crosses the river in the center of the area and here, in the shadow of the bridge towers, lies the approach to the Bear Mountain Trailside Museums and Nature Trails. Trailside visitors are invariably surprised to learn that there are thirty-eight different kinds of wild mammals in this area, despite the fact that the teeming sidewalks of New York City are but forty-five miles away. Some of the mammals are pictured in the following pages. Photograph by Leroy Davies

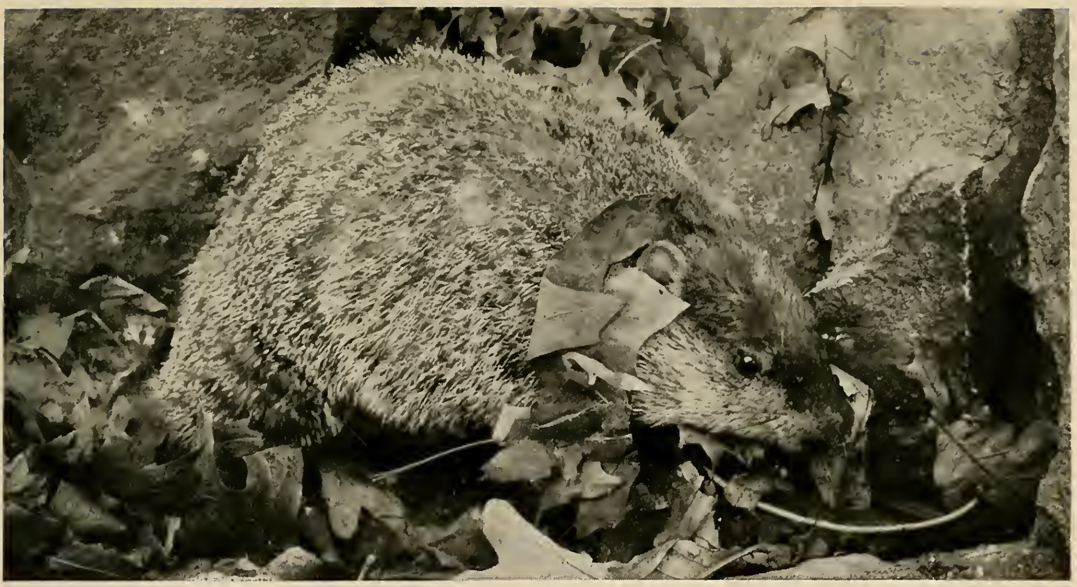
Park Residents All

The erect beaver on the left is representative of many of his fellows occupying ponds throughout the Palisades Interstate Park. Beavers were reintroduced into the region in 1920 and have thrived. It is estimated that they have spread in a hundred-mile radius. Photograph by Clyde Fisher

The Virginia deer, on the left, is familiar to park visitors. In 1910 it was believed that no deer existed in the Highland region. Today the wild deer are numbered by the hundreds, and motorists especially are delighted to view the animals from the roadside in many sections

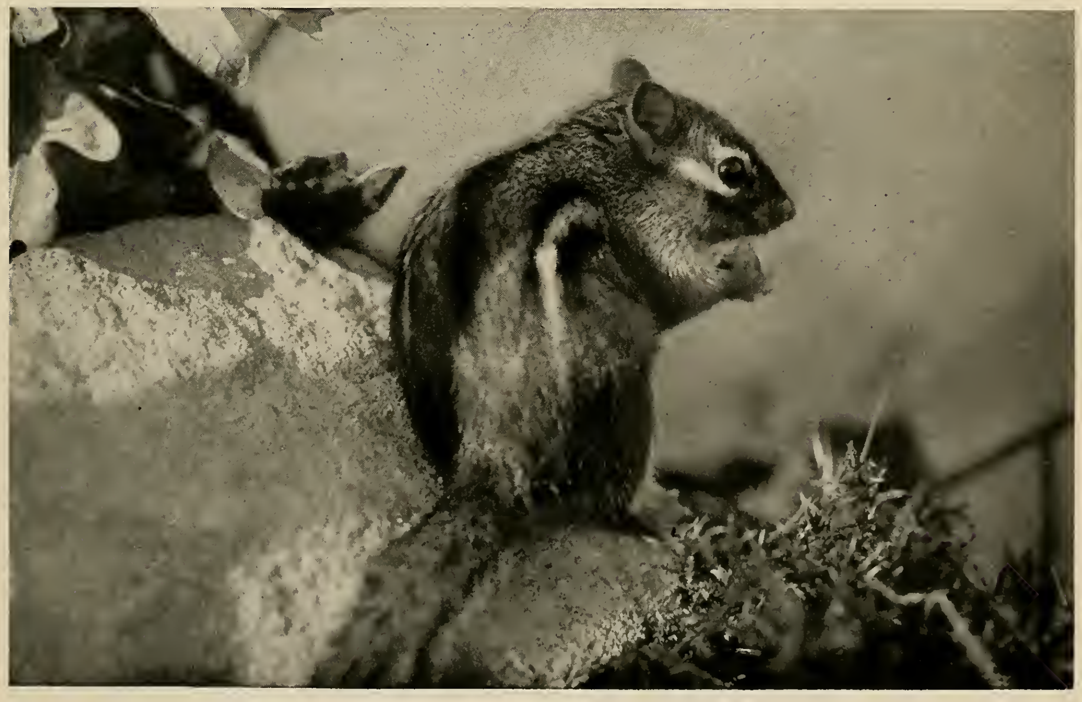
Cottontail rabbits are numerous and are the particular joy of park campers. On summer evenings the nimble rodents may be seen about camp buildings, open fields, roadsides, and lawns. Photograph by Mary C. Dickerson





The woodchuck above is another mammal frequently seen feeding or moving about beside the highways wherever open grassy spaces prevail. Trailside Museum visitors often describe this animal and inquire as to its name. Woodchucks are seen most frequently in the fall. Photograph by Mary C. Dickerson

The chipmunk, nicely posed below, has benefited by the remains of many picnic lunches left by park visitors. A question often asked is "What is that little brown animal with stripes down its back, that scolds us when we walk along the Nature Trail?" The answer is "The Chipmunk." Photograph by Mary C. Dickerson



"Virginia," the gray fox, is a resident of the Trailside Museum zoo. There are many wild foxes, both gray and red, living in the park area, but they are wary creatures, not often seen by the casual visitor. Photograph by Peter Keane

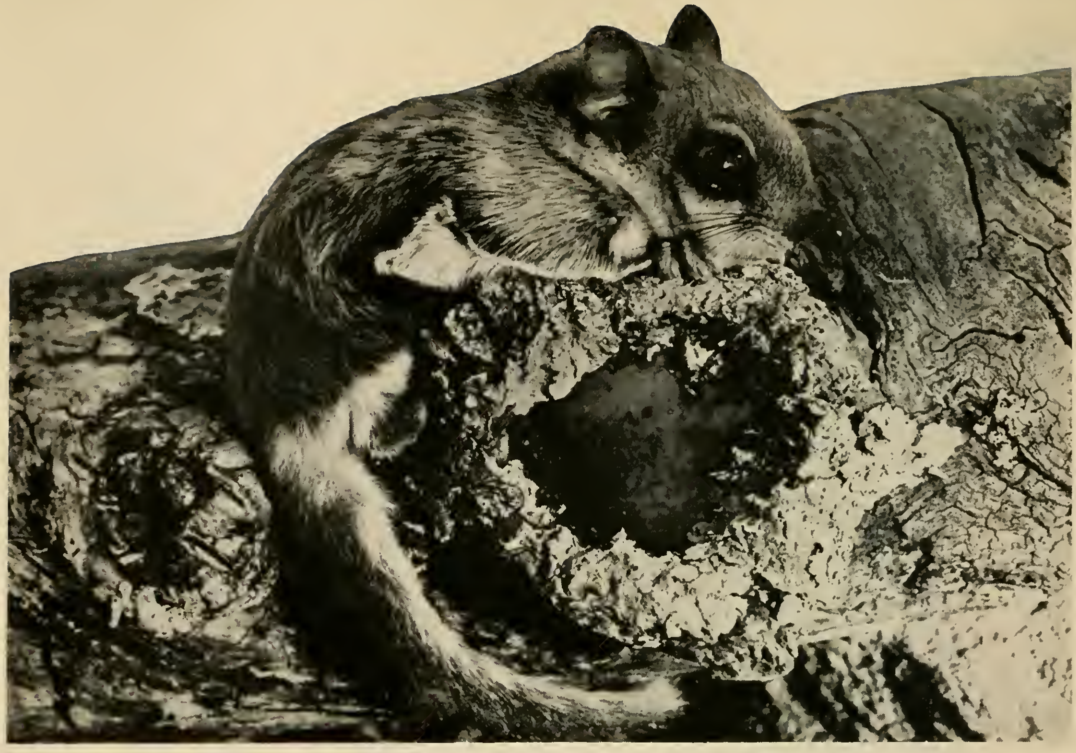
The gray fox, left, often preys upon the little mouse shown below. Photograph by Peter Keane

The white-footed mouse visits camp buildings in search of food and shelter. It is an attractive animal, dainty and well marked. The white-foot is to be found throughout the entire region. Photograph by Mary C. Dickerson

"Coco" the tame raccoon has been with the Trailside Museums for six years. Wild 'coons still wander through park woodside at night. Their footprints are to be seen on banks of many water courses. Photograph by Peter Keane

Campers have learned that the skunk will "mind his own business," when undisturbed. Photograph by Peter Keane

The jumping mouse is a nocturnal animal rarely seen, even by campers. It is believed that it is more common in the Park than eyewitnesses' records would indicate. Photograph by Mary C. Dickerson



The flying squirrel is one of the most attractive members of its family. Its ability to glide through the air has amazed many observers. Photograph by Mary C. Dickerson

MAMMALS LIVING IN A WILD STATE WITHIN FORTY MILES OF THE GREATEST METROPOLITAN AREA IN AMERICA, IN THE CONFINES OF THE BEAR MOUNTAIN — HARRIMAN SECTION OF THE PALISADES INTERSTATE PARK

Opossum, *Didelphis virginiana virginiana* Kerr.
Common mole, *Scalopus aquaticus aquaticus* (Linn).
Star-nosed mole, *Condylura cristata* (Linn).
Common shrew, *Sorex cinereus cinereus* Kerr.
Smoky shrew, *Sorex fumeus fumeus* Miller.
Short-tailed shrew, *Blarina brevicauda brevicauda* (Say).
Little brown bat, *Myotis lucifugus lucifugus* (LeConte).
Silvery bat, *Lasionycteris noctivagans* (LeConte).
Georgia bat, *Pipistrellus subflavus subflavus* (F. Cuvier).
Big brown bat, *Eptesicus fuscus fuscus* (Beauvois).
Northern red bat, *Nycteris borealis borealis* (Müller).
Hoary bat, *Nycteris cinerea* (Beauvois).
Raccoon, *Procyon lotor lotor* (Linn).
Bonaparte weasel, *Mustela cicognani cicognani* Bonaparte.
New York weasel, *Mustela noveboracensis noveboracensis* (Emmons).
Common mink, *Mustela vison mink* (Peale & Beauvois).
American otter, *Lutra canadensis canadensis* (Schreber).
Eastern skunk, *Mephitis nigra* (Peale & Beauvois).
Eastern red fox, *Vulpes fulva fulva* (Desmarest).
Eastern gray fox, *Urocyon cinereoargenteus cinereoargenteus* (Schreber).
Bobcat, *Lynx rufus rufus* (Schreber).
Woodchuck, *Marmota monax rufescens* Howell.
Chipmunk, *Tamais striatus fisheri* Howell.
Southern red squirrel, *Sciurus hudsonicus loquax* Bangs.
Northern gray squirrel, *Sciurus carolinensis lucotis* (Gapper).
Eastern flying squirrel, *Glaucomys volans volans* (Linn).
Beaver, *Castor canadensis canadensis* Kuhl.
Northern white-footed mouse, *Peromyscuc leucopus noveboracensis* (Fischer).
Allegheny wood rat, *Neotoma pennsylvanica* Stone.
Red-backed mouse, *Clethrionomys gapperi gapperi* (Vigors).
Eastern meadow mouse, *Microtus pennsylvanicus pennsylvanicus* (Ord).
Muskrat, *Ondatra zibethica zibethica* (Linn).
House mouse, *Mus musculus musculus* (Linn).
Norway rat, *Rattus norvegicus* (Erxleben).
Meadow jumping mouse, *Zapus hudsonius americanus* (Barton).
Woodland jumping mouse, *Napæozapus insignis insignis* (Miller).
Eastern cottontail rabbit, *Sylvilagus floridanus mallurus* (Thomas).
Virginia deer, *Odocoileus virginianus virginianus* (Boddart).

5000 Years of Exploration

The story of world discoveries as told in "Unrolling the Map," by Leonard Outhwaite

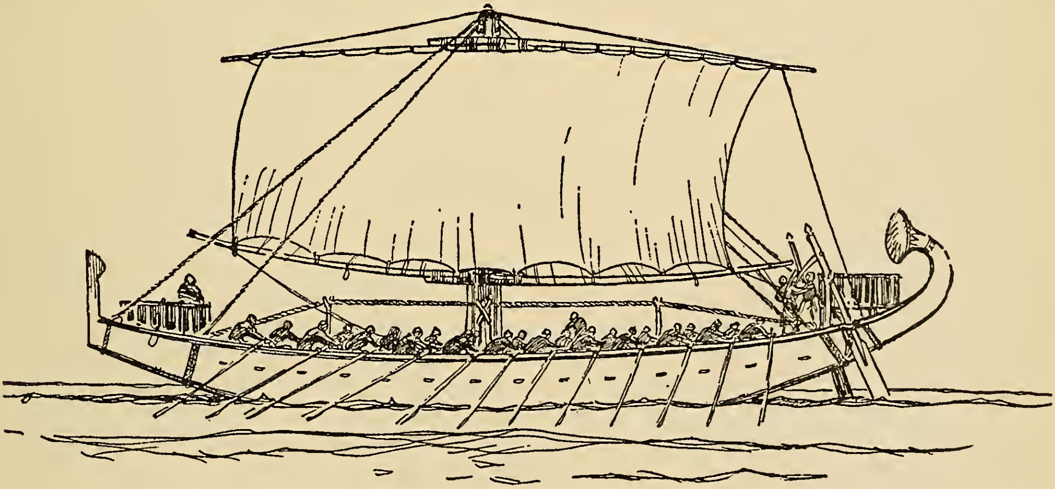
By HAROLD WARD

All photographs from Unrolling the Map

THE HISTORY of Exploration is the record of man's unconquerable courage in the face of the Unknown; of his insatiate hunger for the new, the untried, the remote, and the dangerous. Whether the motive be gold or glory, whether the end be the advancement of knowledge, political aggrandizement, or economic domination — or all three in diverse combination — Exploration is man's answer to the infinitely varied, never-to-be remitted challenge of Nature. The whole of Science may be comprehended in that answer — provided we so define it as to include the ideas of Rigor and Precision, of endless patience in the quest of relevant facts and ordered daring in their interpretation. "Ex-plorare": to search out and bring to light; more literally, *to make flow* what before was stagnant, or frozen, or any way withdrawn from the curiosity and needs of men. To get at and reveal the source of things — of everything, from the energy of cosmic rays to the constitution of the stars; from the stratosphere to the headwaters of the Nile — To unroll the Map of the World!

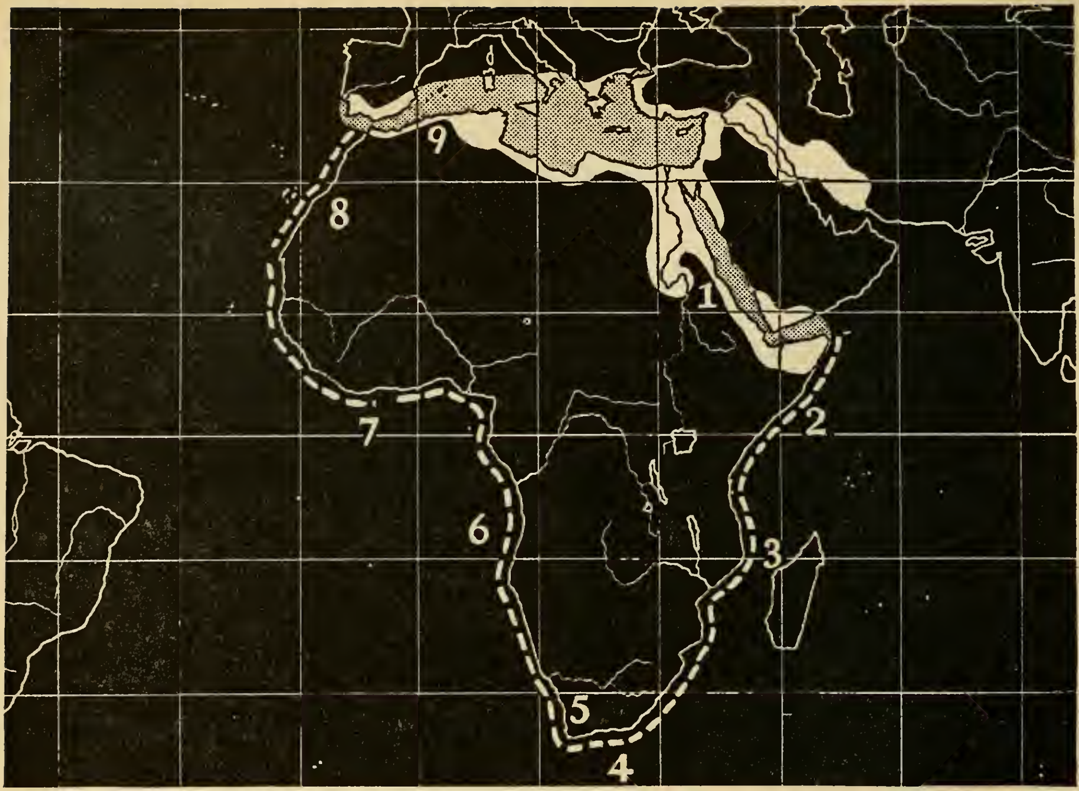
There, indeed, is a story made to grip the somewhat jaded attention of Twentieth Century *Homo sapiens*, who takes his Atlas too much for granted and whose need for adventure must be vicariously satisfied by going "half a mile down" with William Beebe — or ten miles up with August Piccard. And that is the story — five thousand years of it — which (if he be really "sapient") he will make haste to read in the handsome volume before me: *Unrolling the Map: the Story of Exploration*, by Leonard Outhwaite.

Mr. Outhwaite — an experienced traveler with a thorough grounding in geographic and anthropological knowledge — has, in his scholarly book, gone much further, and fared decidedly better, than Hendrik Willem Van Loon, whose picturesque geographic primers have a way of making two questions grow for every one they partly answer. The reasons for this are not far to seek. In the first place Mr. Outhwaite's enthusiasm for his subject is that of a student who has honestly accepted the discipline which it imposes, and who has, accordingly, learned how to avoid



AN ANCIENT EGYPTIAN EXPLORING SHIP

Used about 1500 B.C. on the second known Punt expedition. Lack of strong timbers for proper keel pieces necessitated the rope truss passing around the raised bow and stern and stretched just above the oarsmen on two crutched poles



AROUND AFRICA, 600 B.C.

Reasonable evidence exists that Phoenician sailors under the orders of King Necho of Egypt voyaged around the whole shores of Africa about 600 B.C. The journey, it is believed, took about three years

patronizing his readers. Secondly, under his skilful and dramatic narrative treatment Geography becomes not merely a live subject but a *dynamic* one: each of the fifty-six outline maps shows the world actually growing in response to the urgency of new explorers coming from greater and greater distances. Thirdly, the encyclopedic range of the volume, both in time and in space, although resulting in many omissions and considerable telescoping of what remains (we are almost never informed as to the *areas* of the newly-discovered lands, and information is sadly lacking on the *distances* covered by various expeditions) — this range does give the reader a panoramic view of human exploration which he is unlikely to obtain in so fascinating a form from any other single book.

So much for generalities. But here are the maps: let us, with Mr. Outhwaite, unroll a few of them: regretting, perhaps, that none is supplied with scales of distances in miles, and that only the world maps carry latitude and longitude notations.

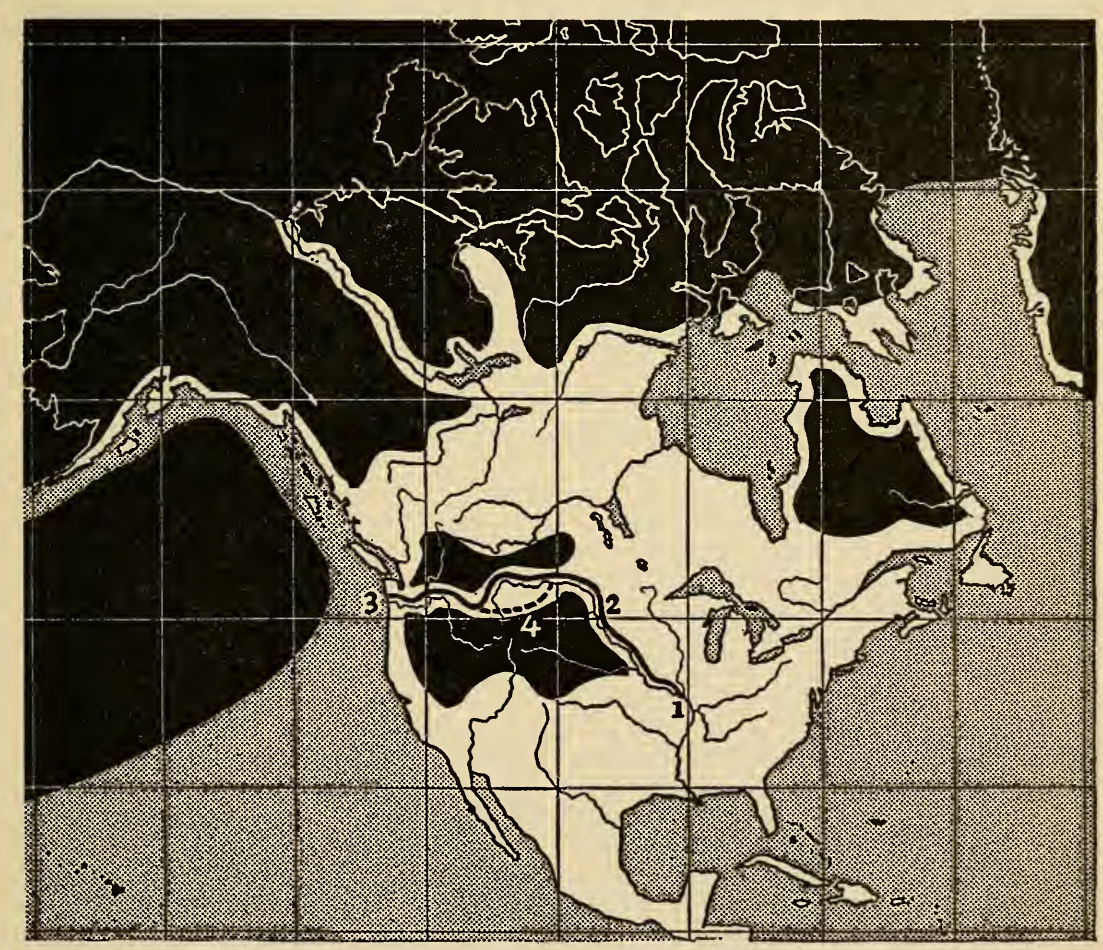
We begin in the Mediterranean area, around and near which clustered the early Empires: Egypt, Phoenicia, Assyria, Sumer, Elam, legendary Crete and the Greece of Homer. From the first of these started on his travels, about 2750 B.C., the enterprising Hannu, who sought wealth and adventure in far-off Puoni, the "Land of Punt," whence he brought back much gold and silver, myrrh, and many precious woods. Today portions of this "Holy Land" of the Pharaohs, under the name Abyssinia, are bitterly harassed by a government whose people commemorate in their name the deeds of an antique tribe — the Italici. More than 2000 years later — but still a good 600 years before Christ, another Egyptian, King Necho, sponsored one of the most remarkable expeditions in all history: the circumnavigation of the African continent by unknown Phoenician sailors. Herodotus, who narrates this three-year feat in a single paragraph of his famous History, had his doubts: oddly enough (as Mr. Outhwaite points out) his chief reason for questioning it is today our principal reason for believing it: "namely, that in sailing around Libya they had the sun on their right hand." This is precisely what would happen in sailing south of the Equator: furthermore, the length of the voyage, the direction of transit (east to west), and the landing stages recorded, are all in accord with our present knowledge of ocean currents and trade winds prevailing around Africa.

With Alexander the Great exploration was a by-product of an overweening military ambition: to this restless forerunner of imperialism we owe our first knowledge of considerable areas in the Balkans, the Near East, Afghanistan and other regions to the north of India. Kashmir and the city we know as Amritsar were on his route, and he was making ready to explore the Ganges when his "soiled and tattered army" broke down.

An early astronomer, who combined an interest in scientific observation with "a desire to break the Carthaginian monopoly on trade with the Atlantic coast" was first to unroll the map northward to the Land of Thule — thereupon the British Isles and portions of Western Europe were discovered. This was in 310 B.C. — but more than 2000 years passed before this early Marseillaise, Pytheas, received his due credit. One of the first in that noble band of scientific explorers, Pytheas noticed everything, systematically discounted the marvelous, and served Geography well. Mr. Outhwaite writes of his observations that they

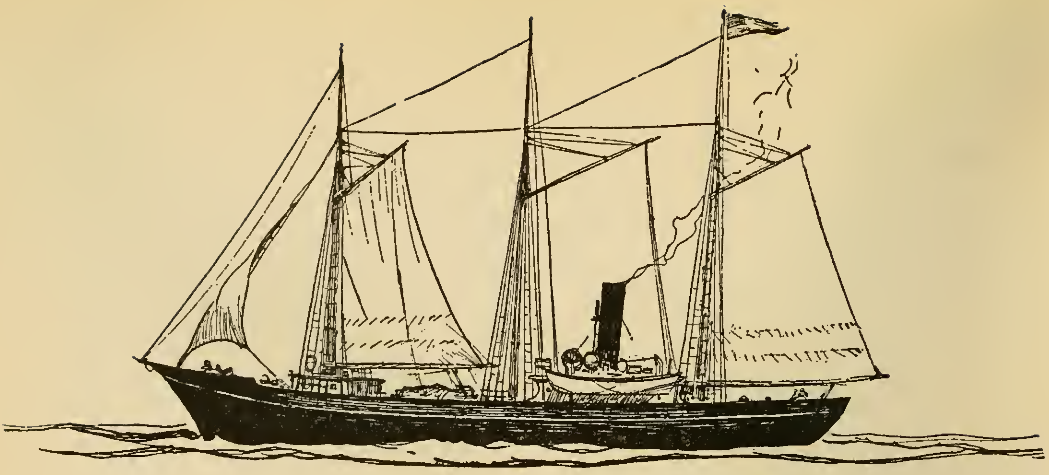
> are often apt and reasonable. In Cornwall he observes how the tin ore lies in the ground and how the miners dig galleries through the earth-veins that separate the ore beds. How they smelt the ore and form it into ingots "like knuckle-bones." He observes that the miners are friendly, gentle and intelligent, and says that this is probably due to the fact that their trade brings them in contact with a number of foreign people.

In view of England's colonizing genius and



Known and Unknown North America in 1806

The famous 8000-mile journey of Lewis and Clark cut a swath through the blind spot of the West. The remaining area in the United States was to become known soon after this period



PEARY'S VESSEL, THE "ROOSEVELT"

The success of Peary in 1909 depended in part upon the skilful handling of this sturdy ship under the command of Captain Bob Bartlett. The "Roosevelt" specially designed to withstand the pressure of ice, was driven by both sails and engine

the stress laid by modern anthropologists on the cultural importance of contacts among peoples, the last statement reveals Pytheas as an exceptionally shrewd and honest traveler.

That Columbus "discovered" America in 1492 is one of those pleasant fictions which simplify the tasks of schoolboys. The Norse settlements at Vinland and Markland were established as far back as the Eleventh Century — and thereby hangs an extraordinary tale. "In 1898," to quote our author, "a Swedish immigrant named Olof Ohman was clearing up stumps in a wood lot near Kensington, Minnesota, when he pulled up the stump of an aspen whose roots were growing right around a rough-hewn stone." So far all is in order, but —

On the face of this stone were found twelve lines inscribed in a peculiar language. An indefatigable scholar, Mr. Hjalmar Holand, after more than twenty years of research, which involved forestry experts, geologists, linguists, and archæologists, has all but succeeded in proving that this inscription commemorates the settlement, in Minnesota, of a small colony of Swedes and Norwegians prior to the year 1362. It is believed that this is the same expedition which was sent by King Magnus Erikson in 1355 to "redeem" from paganism earlier Norse settlements in Greenland and on the continent. The missionary trail led westward through the unimaginable wilds of Canada and ended in the very region that was to become, more than five hundred years later, the "promised land" of America's Scandinavian immigrants.

Skeptics may — and do — smile at this remarkable story. But, there is the "Kensington stone," and Mr. Holand's substantial, carefully documented volume to show, once more, the far-flung emprise of the Vikings.

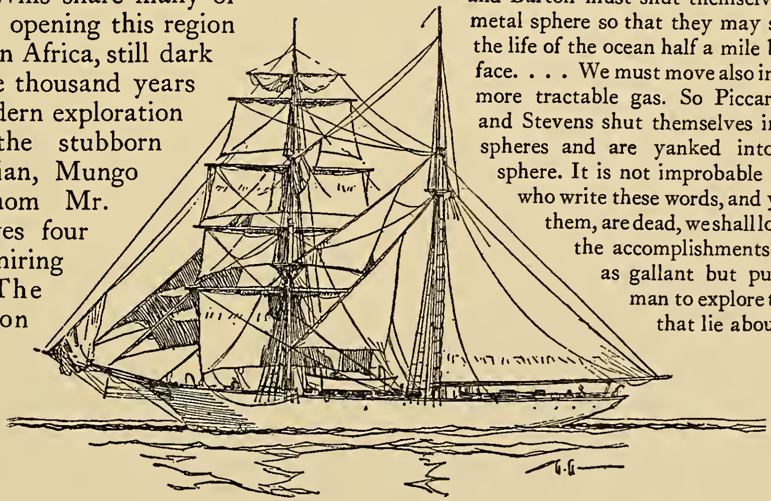
No one people, however, has monopolized the pageant of exploration. Mr. Outhwaite's 300-odd pages are such a catalogue of ships and heroes as not even a Homer could fitly celebrate. Here are the Arabians, Soleyman and Ibn Battuta, who, in the dismal night of Europe, roam through Asia and India, missing little on the way, either of life or knowledge; Marco Polo, all eyes and wit and energy, discovers the vast Empire of Kublai Khan, and is set down a dreamer of dreams. Henry the Navigator inaugurates "the great age of adventure" during which Continents flower like gardens amid the deserts of man's ignorance: red for blood, yellow for gold, purple for the lust of conquest and the pomp of power. "Malacca Henry," a treacherous East Indian slave in the service of Magellan, deserves — insists Mr. Outhwaite in a curious footnote — the real credit for the first circumnavigation of the world attributed to his master: but Cortes, Cabeza de Vaca, de Soto, Pizarro, and their fellow Spaniards still have their "honors" in South and North America, despite many failures and cruel blunders.

As might be expected, Mr. Outhwaite gives generous space to the achievements of the more famous explorers, although for each region he lists a number of the lesser-known but significant figures, thus giving to his narrative added value as a work of reference. Alexander von Humboldt, Darwin, Bates, and Wallace are liberally treated in the section on South America — but one misses any mention of the eccentric Waterton and the Nicaraguan scientist-explorer, Thomas Belt. In Asia the exploits of Vitus Bering help to explain the firm grasp of Russia on her eastern possessions, and there is a brief note on the classic geographic researches in China of the Baron Ferdinand Paul Wilhelm von Richthofen, followed by a useful chronology of exploration in Tibet. Nicholas Prjévalsky, "greatest of the Russian explorers" is duly honored for having been the first of the moderns to put Mongolia on the map, although earlier efforts had been made by the Jesuits, Huc and Gabet: today Roy Chapman Andrews has filled in many of the blanks left by Prjévalsky, particularly around the Gobi Desert — but there is no mention of Owen Lattimore, whose *Desert Road in Turkestan* is the record of a very notable journey.

Arabia gives us the heroic Richard Burton, the rugged and compassionate Doughty, Gertrude Bell, and Col. T. E. Lawrence, that romantic adventurer who seems to spend his life avoiding the notoriety of his own quite deliberate actions. Australia and the whole of Oceania are still memorials to Capt. Thomas Cook, although La Perouse, Abel Tasman, R. O'H. Burke and his companion W. J. Wills share many of the honors for opening this region to the world. In Africa, still dark after some five thousand years of history, modern exploration began with the stubborn Scotch physician, Mungo Park — to whom Mr. Outhwaite gives four pages of admiring attention. The restless Burton turns up on the Nile, whose headwaters he, with John Speke, proceeds to explore. David Livingston, of course, gets into the famous difficulties from which he was extricated by the American journalist, Henry Morton Stanley — and Africa was well on its way to becoming that colossal grab bag of imperialism later to be associated with the name of Cecil Rhodes — of whom, perhaps sagely, Mr. Outhwaite, gives no account.

The Poles, North and South, receive a hundred pages of vivid treatment, beginning with William Barents back in the Sixteenth Century and working down through a stately procession of valiant men to Peary, Amundsen, Stefansson, Captain Scott, Sir Ernest Shackleton, and the Americans, Byrd, Wilkins, and Ellsworth. A chapter on "The Pole by Air" tells the tragic story of Salomon August Andree, whose balloon carried him out of history one day in 1897; followed by brief accounts of the Amundsen and Ellsworth expeditions, of Admiral Byrd, and General Umberto Nobile's ill-fated "Italia" exploit.

> Finally — [if we may conclude this sketchy outline of a notable book in its author's own words], finally, we are witnessing today a change in exploration which may be of the greatest ultimate importance. Exploration is moving from a two-dimensional to a three-dimensional realm. We no longer explore the mere surface of the earth. It is not an accident that man has launched himself into the air and moved beneath the surface of the sea just in that period of history when the whole surface of the earth has become known to him. . . . Beebe and Barton must shut themselves in a heavy metal sphere so that they may see and sense the life of the ocean half a mile below its surface. . . . We must move also in a lighter and more tractable gas. So Piccard and Settle and Stevens shut themselves in light metal spheres and are yanked into the stratosphere. It is not improbable that before I, who write these words, and you, who read them, are dead, we shall look back upon the accomplishments of these men as gallant but puny efforts of man to explore the far worlds that lie about him.



Famous Non-Magnetic Ship "Carnegie"

Unique in the history of exploration, this vessel was built entirely without iron or steel. Her researches in every ocean of the world contributed vastly to the knowledge of terrestrial magnetism and nautical science

Alligators of Georgia

Picturesque saurians that carry on a strange existence in their deep-water dens in the Okefenokee Swamp, despite threatened extinction at the hands of the hide hunters

By Charles Newton Elliott

District Forester, Augusta, Georgia

Nowhere else on the face of the earth does the sun grow as fat and lazy as it does in the Okefenokee Swamp at the harvest time of the year. The afternoons of late summer are peaceful and warm, filled with clusters of gold and purple leaves, brimming with that mysterious sense of something dreamy and quiet which compels one to slow the tempo of his existence and himself fall into a pleasant, dreamy mood.

It was just such an afternoon that we left the marshlands behind and turned our faces southward toward the coast. The Okefenokee lay behind us, the St. Mary's River ahead, moving majestically toward the Atlantic Ocean, one hundred miles away by watery trail.

We drifted along, unhurriedly, our eyes alert for early fall migrants, making low comments on the trees, the numerous birds, and the natural scenic beauty of this blackwater stream. Our fishing rods lay in the bottom of the canoe, and a big bass, potential supper, drifted with lazy motions of his fins behind the stern, attached securely with a wire hook through his lips. We did not know or care about where we should camp for the night. The present was, in itself, sufficient.

Presently Stephens, in the bow of the canoe, dug his paddle into the small of my back.

"Look!" he whispered.

He pointed to one of the long, white sand banks which are usually exposed at that season of the year. A group of tiny alligators, basking in the mellow sunshine, lay checkered over its surface.

Stephens turned the prow of our craft shoreward and we glided quietly to the sand bank. The undersurface of the canoe rasped against the sand and the nearest baby alligator raised its head to look at us. Suddenly he became alarmed and scampered for the water. The others, galvanized into action by his sudden move, followed. I shot out my hand and caught one of the tiny reptiles as it scuttled past the boat.

"Hold it," said Stephens. "I've got an idea that we might be able to entice this young fellow to call his mother to the scene. I'd like to see what she would do."

We stepped out of the canoe and pulled it ashore. Stephens held the young reptile aloft by its tail. It emitted a squeaking noise, much like an alarmed call for help. We stood there several minutes, but the mother did not appear to rescue her baby. Perhaps such things never occur.

We continued on our journey down the river and probably would have forgotten the incident, had we not, during the afternoon, found an old riverman fishing from the bank with a long cane pole. We stopped to talk with him and to get his ideas about the river, the wilderness, and life in general. During the course of the conversation, Stephens told him of our escapade with the young alligators and showed him the reptile we still held captive in the bottom of the canoe. The old man snorted at our seeming lack of intelligence.

"Lucky for you," he stated, "that the old lady was in the water instead of on the bank. You'd be shoveling coal now. Have you ever seen an old 'gator run?"

"Why, I thought they just crawled," I said. "I didn't know they could run."

I spoke untruthfully, because I wanted the old fisherman's version of an alligator's speed.

He snorted a second time.

"Kin they run?" he said. "I've seen 'em. They kin come b'iling down the river bank like a uprooted tree. I've seen one of the big ones, which are all gone now, knock a hundred-pound porker into the river with his tail, roll in on top of him, and swim off with him in his jaws. If that old she'd come a pilin' down on top of you after her young 'un . . ." He snorted a third time, leaving to our own imaginations what might have happened.

Alligator is said to be a corruption of the Spanish name "El Lagarto" which means "the lizard," but in the biological order of all life, the alligator is almost as closely related to birds as to lizards.

An Ancient Type

Alligators might well have come down to us from the age of gigantic reptilia. Their plated armor, their bellowing voices, which may be heard on summer nights in the Okefenokee Swamp, their peculiar webbed feet, which serve them as well on land as in water, all make them capable of surviving under almost any environment. They have chosen the moss-hung cypress forests and the watery wastelands for their home. They love the solitudes, away from the haunts of man. Their appearance, their environment, seem to place them in a position where they would survive through the centuries.

Hide hunters, though, have taken heavy toll, and the last decade has seen the alligators fast disappearing in many sections of the south. A few years ago, when hides brought from $2 to $6 each, they were hunted day and night, and by every conceivable method known to man.

The hunter of the Okefenokee Swamp knows many ways of collecting these reptiles. A great number of the alligators in the Okefenokee make their homes on the "prairies," those treeless areas of water and floating earth, by cutting away the lily pads and roots and making deep-water dens, locally called "'gator holes."

One of the most popular methods of getting skins is to hunt the reptiles at night with a light. The swamper pushes his boat noiselessly into the open water of the den and cuts on a powerful spotlight. He searches the fringe of marsh around the pool and presently catches, in the beam of his light, two ruby-red balls, which might well be living coals of fire. Using a high-powered rifle, the hunter drives a bullet between the eyes, or into one of them.

Sometimes alligators are hunted in the daylight hours. The swamper prods on the floor of the den with his long pole. When the reptile is located, it is jabbed in the back with a barbed hook and brought to the surface. Another popular method of collecting hides is to catch the alligators on huge iron hooks baited with beef liver.

A few years ago one could not approach a "landing" in the Okefenokee Swamp without becoming nauseated at the terrible stench of decomposed saurian bodies. They were brought to the landings and skinned, and the bodies piled in a mass at one side. I have seen alligator bones stacked several feet high at the landing on Billie's Island.

Even now, when the market for hides is as far away as Germany, and when they are valued at less than a dollar each, the work of extermination goes on. Each year hundreds of hides are brought out of the Okefenokee and other southern swamps. The hunter has left the open water and gone back into the interior to take out skins, not only those of commercial length, but many too small to sell.

Larger Specimens Gone

Large alligators have become a rarity in the south. A ten-foot specimen is far above the average. The early explorers noted specimens thirteen feet long and longer. William Bartram, the naturalist who traveled through the wilderness of the southern states more than 150 years ago, made interesting observations on this reptile. Says Bartram:

> My provisions being scanty, I determined to catch some trout for my supper. Not thinking it prudent to take my fusee with me, lest I might lose it overboard in case of a battle, I furnished myself with a club, went on board and penetrated the first line of those (alligators) which surrounded my harbor. They gave way, but being pursued by several large ones, I kept strictly on the watch. Ere I had halfway reached the place, I was attacked on all sides, several endeavoring to upset the canoe. My situation now became perilous to the last degree. Two very large ones attacked me closely at the same instant, rushing with their heads and parts of their bodies above the water, roaring terribly and belching floods of water over me. They struck their jaws together, so close to my ears as to stun me, and I expected every moment to be dragged out of the boat and devoured. But I applied my weapon so effectively about me, though at random, that I was so successful as to beat them off a little, and I made for the shore.

Bartram goes on to explain that the reason for the large number of alligators at this spot was the collection of fish in the pass of the St. John's River, where he was at that time. He says:

> How can I express myself so as to convey an adequate idea of the prodigious assemblage of alligators to the

reader and at the same time avoid raising suspicions of my veracity? They were in such incredible numbers and so close together for half a mile from shore to shore that it would have been easy to have walked across on their heads had the animals been harmless.

These saurians give the impression of being slow on dry land. In the zoo I have seen them crawling on their bellies, with elbow joints drawn up behind them, level with their backs. They seem to have no other element but the water. This impression, however, is false. When he pushes his body away from the ground with his feet, an alligator can run like a lizard. I have seen leathery individuals on the Suwanee River, race twenty feet down a sand bank and splash into the water like a log thrown in, before I could reach into the bow of my canoe and pick up a gun. Once I chased a small alligator for fifty yards through the palmettos on the edge of the Okefenokee Swamp before I caught it.

An alligator's tail is much more formidable than his jaws, and he uses it to secure his food, as well as for fighting purposes. His jaws are built on powerful hinges, but all the power lies in closing, rather than in opening them. I have held shut with one hand the snout of a five-foot alligator while he struggled to break away, and I am no stronger than an average man. Probably the knowledge that if he did get those powerful jaws open near me, my natural physique would need patching, added a bit to the power of my grip.

Alligator vs. Bear

It seems that an alligator would be king in his element, the water, but old timers in the Okefenokee Swamp assure me that he is not. Lem Griffis and Dan MacMillan, guides extraordinary of the swamp, have convinced me that alligators will often attack bears swimming across a lake, and that in such an encounter, the alligator usually comes out second best.

Dan told me of seeing such an incident not long ago. He was fishing in the lower end of Billie Lake, when a bear came down to the edge of the water, slipped in, and started across. An old alligator, lying in the weeds, followed. In the middle of the stream, the alligator suddenly darted forward, seized the bear by his fur collar, and pulled him under. As they went down, Dan saw the bear turn and rake steel-sharp claws at the face and shoulders of the reptile.

For a few seconds the water boiled where they had disappeared. The bear remained under the surface long enough to have been drowned, and Dan was about to resume his fishing, when the head of the bruin appeared. He calmly swam on across the lake, climbed out on the other side, and continued his interrupted journey over the half rotted logs and débris of the swamp floor, as though nothing had happened.

Dan also tells of killing an alligator in Chase Prairie. The saurian had half the meat torn off its face, so that its jaw bone was exposed. Big claws, obviously those of a bear, had ripped through the leathery hide of its belly. Dan was of the opinion that the same bear tore away the flesh of its face.

In the Okefenokee Swamp, alligators lay their eggs in big heaps of grass which they build up on one side of their dens. They construct this nest themselves, deposit their eggs, and then pull grass over the top of it. Turtles, in lieu of a soft, sandy beach, often follow them and lay eggs in the same nest, above those of the alligator.

The year 1931, when the big drought came to the southland and the water of the Okefenokee dried up to approximately 1 per cent of its normal volume, saw an appreciable decrease in both the bear and alligator population of the swamp. Hunters were able to travel into portions of the Okefenokee which had never been penetrated. They were able to locate alligator holes which were invisible in high water, drive out the saurian inhabitants, and take home many leathery scalps. Many times I found alligators traveling across dry country, seeking new homes when the one in which they lived had dried to baked mud. That same year, 114 bears were killed on the upper reaches of the Suwanee River, at one fishing camp alone. Alligators were taken out in proportionate numbers.

These rugged, picturesque old saurians have been preserved for us since time immemorial, and the species should not be allowed to face such a tragic climax, but civilization is constantly making inroads on their homes in the wilderness, and unless some action is taken for their preservation, they are doomed to extinction even in this generation.

Photo by Julian A. Dimock

'Gator Shooting

The alligators of the southland have become exceedingly scarce in many areas where their numbers were formerly legion. White hunters have sought 'gator skins for three hundred years and sportsmen have bagged countless thousands. The drainage of swamps has accounted for the death of untold numbers.

Mr. Charles Newton Elliott, author of the foregoing article, has spent many years in the investigation of the alligator in its native haunts. It is his opinion that the Okefenokee, or the "Great Swamp," should be set aside as a Federal preserve for wild life, thus protecting the alligator in this region.

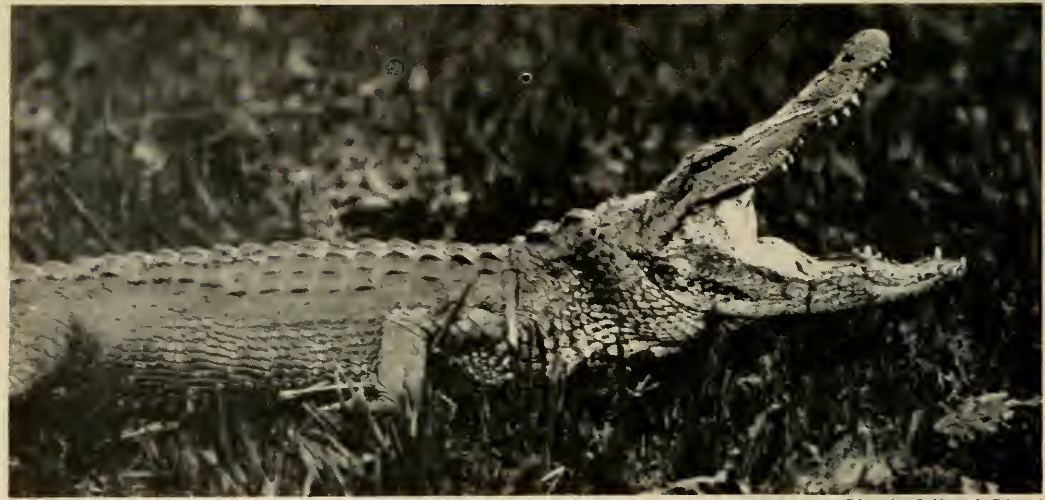
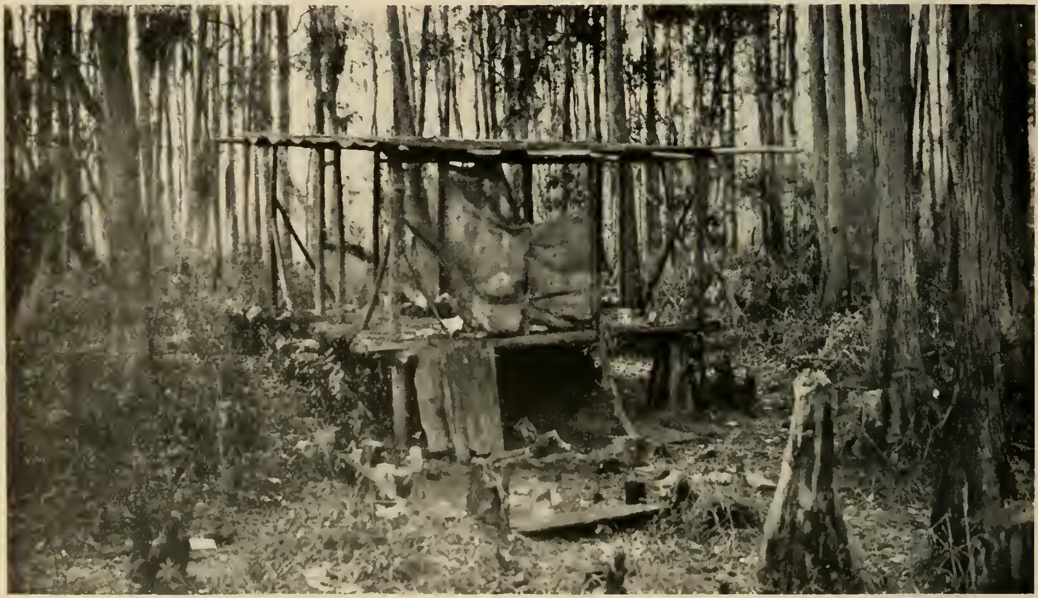
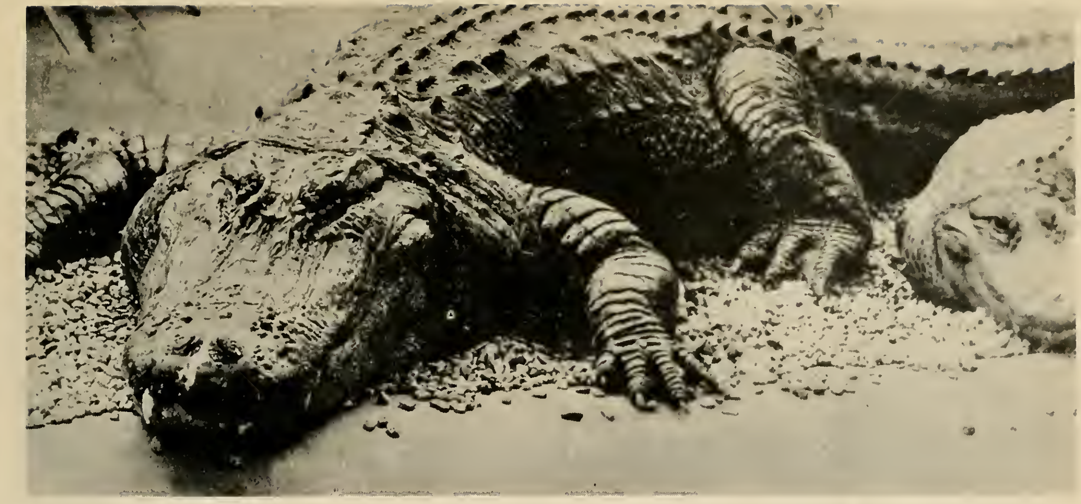


Photo by Julian A. Dimock

Above: The array of sharp, strong teeth in the alligator's capable jaws spells doom to many swamp creatures. The teeth may be shed as new ones push upward to take their places. One "crunch" of the huge jaws can easily destroy a dog, and the fate of ducks, geese, swimming marsh rabbits and other animals and birds, when caught by the 'gator, may well be imagined.

Below: This rude platform, supported by poles and cypress "knees," serves as a shelter for swamp hunters. Burlap sacking keeps out the wind, and slabs of corrugated tin form the roof. A number of similar camps are found throughout the Okefenokee. The hunter works all day in the swamp, and returns to the shelter at night to eat and sleep, often making his bed upon the ground.





Above: A strange thing about the jaws of the alligator is the fact that, despite their large size, they may be held together by a man with comparative ease. The enormous muscular power centered in the 'gator's jaws is used mainly in shutting the reptilian trap rather than in opening it. The large teeth of the lower jaw shut into pits in the upper jaw, instead of into marginal notches.

Below: A scene typical of the "Big Water" sections of the Okefenokee Swamp. In former years alligators were plentiful in this body of water. Today the visitor who penetrates the swamp for short distances considers himself fortunate if a 'gator is seen during the journey. In the deep interior of the swamp the reptiles survive in rapidly diminishing numbers.

Photo by Charles Newton Elliott

Photo by Charles Newton Elliott

Swamp's Edge

Above: Although 114 bears were killed in the big drought of 1931, the black bear is still seen in the Okefenokee country and hunters secure skins throughout the year. The swamp is so huge (640,000 acres) that many retreats for birds and animals still remain. The people dwelling in and near the swamp are by no means as destructive to wild life as are the visiting shooters. The elderly gentleman pictured above stands among the palmettos, on the lookout for game. He is a typical "swamper" who has spent a long lifetime in the region and who represents a vanishing group of true American frontiersmen gifted in the arts of woods-lore in all its phases.

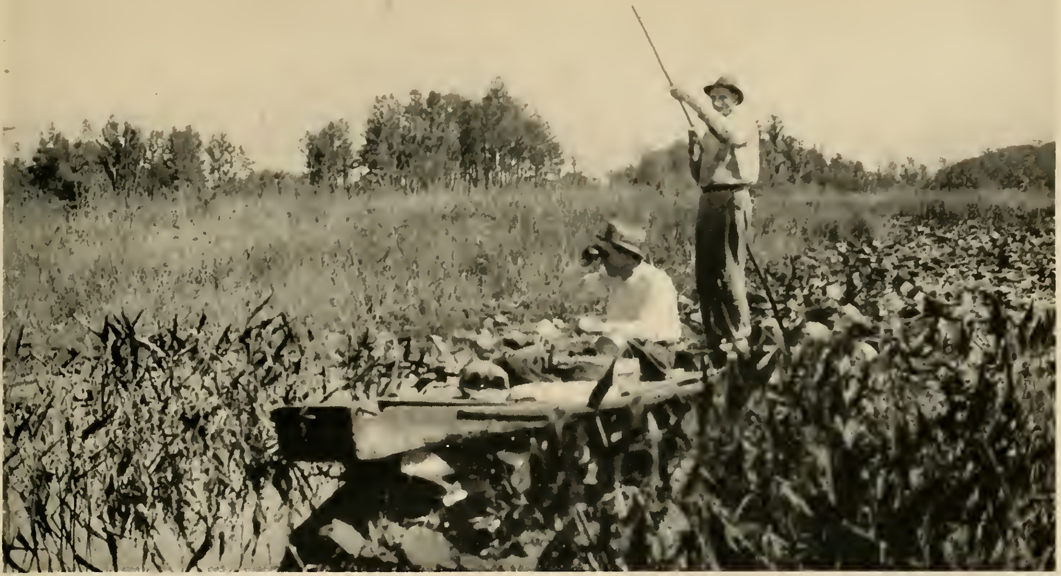
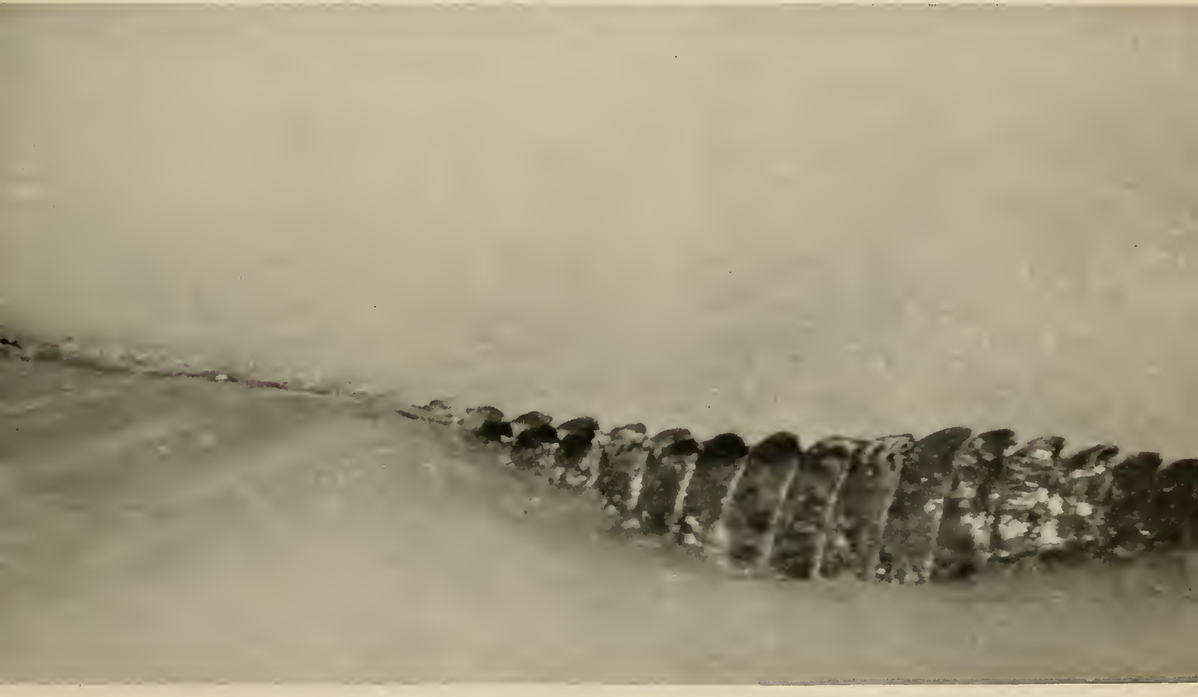


Photo by Charles Newton Elliott

Poling a "Run"

Above: The watery passages, threading the huge swamp, form the only means of approach to the interior where the hunter now goes to take out skins. Small, flat-bottomed, shallow boats are propelled mainly by long slender poles. The local swamp travelers invariably stand bare-footed upon the back seat and exhibit great skill in guiding and pushing the clumsy craft. The patches of water lily pads, or "bonnets" as they are called, often impede the boat's progress. Nevertheless, a capable "swamper" can manipulate the prong-ended push pole in such a manner that the boat scarcely loses momentum as it is forced through the shallow water.

Photo by K. E. Webb



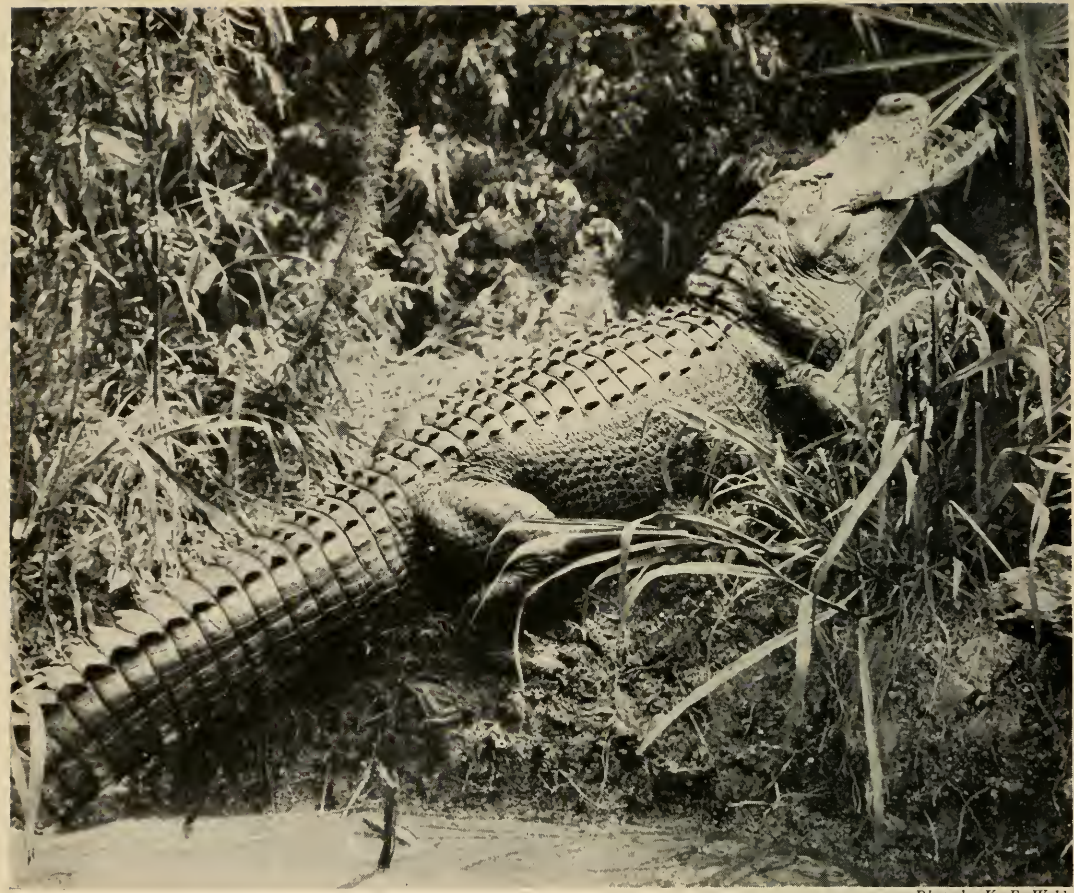


Photo by K. E. Webb

Above: This large fellow has succeeded in thoroughly discouraging a chicken. Despite the alligator's size and strength, there are few records to show that persons have been aggressively attacked. The reptile's first endeavor is to disappear as speedily as possible when man appears on the scene.

Below: From appearances it would seem that this young 'gator was investigating the automobile. Alligators sometimes travel overland from one pool to another. As a rule, however, they prefer the waterways. Individuals surprised ashore make a "bee line" for the water and dive in with a resounding splash.

Photo by Charles Newton Elliott

Above: Alligator "farms" have proved successful, especially in Florida, despite the slow process of raising the "product." The skins have many commercial uses, for the day of the "alligator bag" has not passed.

Below: Comparison between an alligator and a crocodile. The alligator on the left has a broad head, rounded at the snout, while the crocodile on the right has a pointed snout and a triangular head.

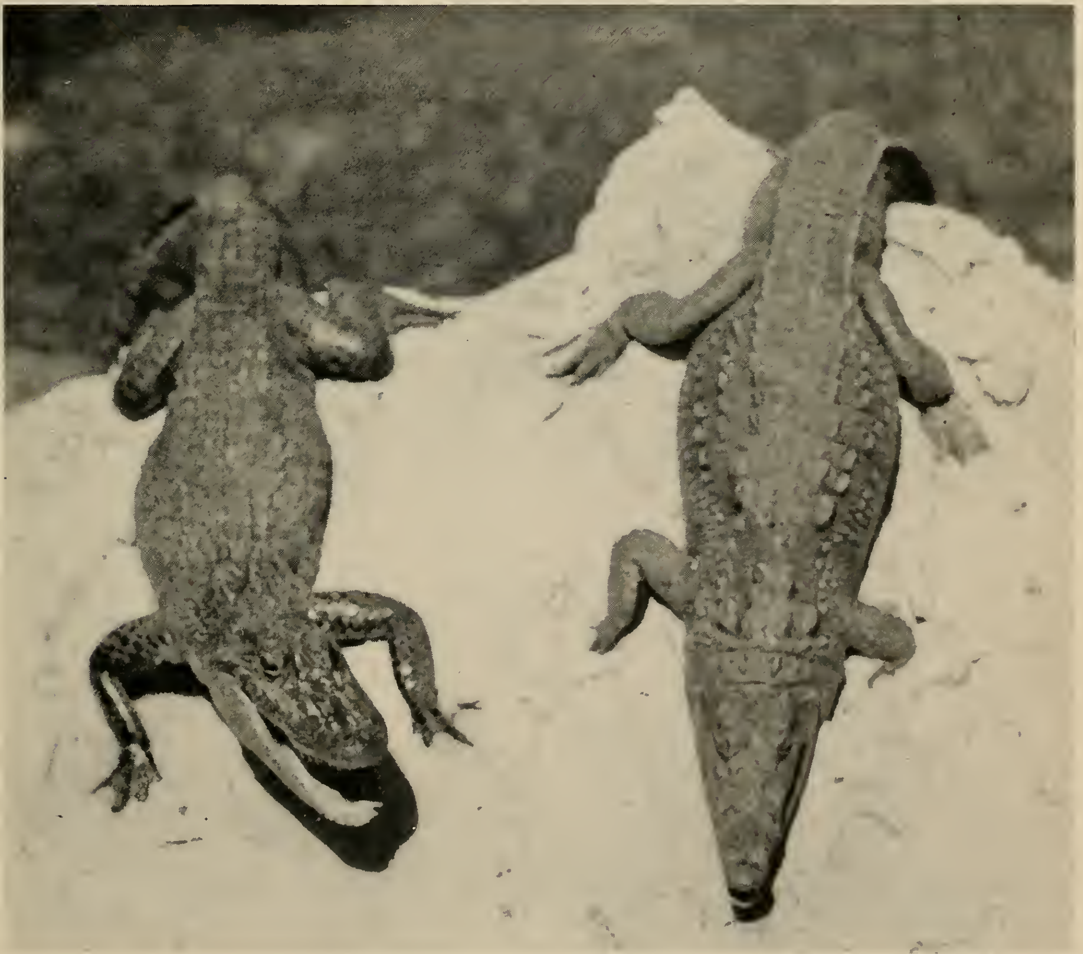
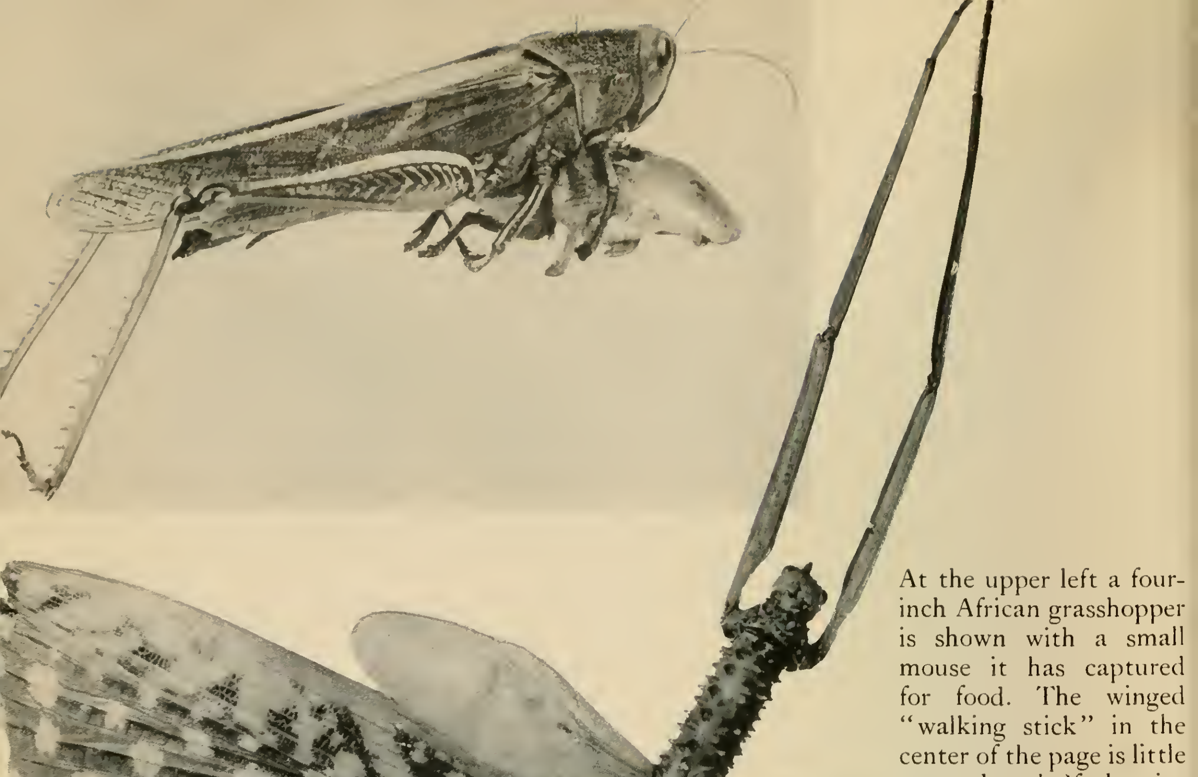
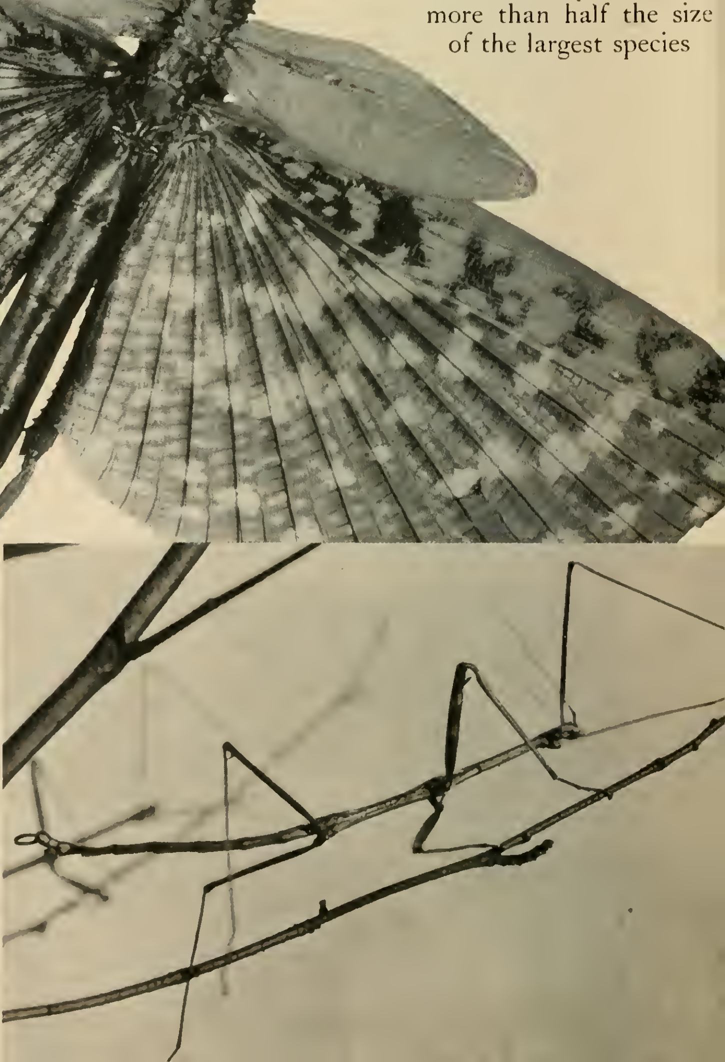


Photo by K. E. Webb



At the upper left a four-inch African grasshopper is shown with a small mouse it has captured for food. The winged "walking stick" in the center of the page is little more than half the size of the largest species



The "walking sticks" of the United States are long, slender, wingless creatures, closely resembling twigs

Insect Giants

Some members of the insect world which are interesting because of their huge size

By C. H. Curran

Assistant Curator, Department of Entomology, American Museum

Among most groups of animals it has been, as a general rule, the largest and most ferocious creatures that have created the greatest interest among men.

This interest is due in large part to the conceit and braggadocio that is an inherent part of man's nature. But it is not alone the size of the animal that induces man to search it out and slay it. There must be, in addition to bulk, no little element of danger to the hunter, due to the prowess of the hunted, and he must feel that he is matching his wits against a foe worthy of his mettle.

And even though man has perfected implements and a technique that greatly reduces the chances against his being the vanquished instead of the victor, the thrill of the sport still remains. Were this not so, the hunt for the elephant, the lion, the tiger, and other animals would today be such an insipid affair that it would fail to attract those sportsmen whose natures demand a thrill and to whom conquest gives real exultation.

In the case of insects a very different situation exists. It is not the largest insects that cause us the most trouble, but those of medium to small size. Few insects having a length of more than half an inch are dangerous to man or to his agricultural products, threatening his health or his crops, and few of those greater than this in length cause actual damage or are major pests.

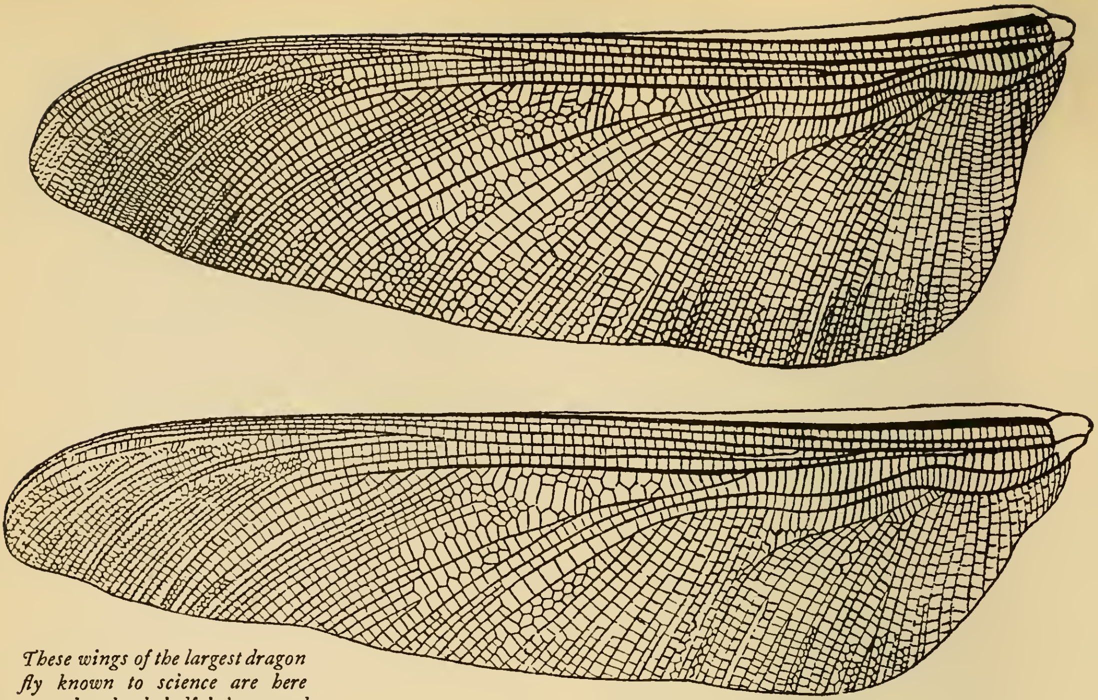
It is the injurious insects that come to our attention and, by their very abundance and usually unattractive appearance, cause many of us to ignore this dominant group of animal life, with the result that we never discover that there are many insects having a length as great as that of approximately twenty-five per cent of our birds — that is to say a length of more than six or seven inches.

Perhaps it would be as well to explain the methods of measuring these two groups of animals in order that the comparison may be better understood. A bird is placed on its back and measurements taken from the tip of its bill to the tip of its tail; an insect is measured by the length of its body, exclusive of appendages such as tail or antennæ, although some are measured by the wing expanse.

Large insects are, of course, giants among their kind, just as the elephant and whale are huge among the mammalian fauna, and as the dinosaurs were among the reptiles. Mention of the giant lizards brings to mind a parallel instance of huge size occurring among the insects of the distant past, and makes one wonder what tales man's predecessors might have woven if they had existed in a highly developed form at that time, about these invertebrate monsters of the air. Reference is made, of course, to the huge dragon flies having a wing expanse of up to thirty inches.

Today we have no dragon flies that can even approach in size those creatures that once soared over France, and probably other regions of the earth. If the belief, quite widely held among the uninformed, that our present-day dragon flies (sometimes called darning needles) will sew up the mouths of people, particularly of children who tell lies, has been engendered by observing the actions of the present-day insects, it is quite possible that the inhabitants of the world in prehistoric times might have had even more fantastic stories to relate about the largest insects of which we have any records.

Possibly some one may ask why these large insects have disappeared from the earth and why we do not have such large creatures today. The last part of this question may be answered first with the statement that we do have insects that are relatively as large as the extinct dragon flies, at least in length, although, their wings not



These wings of the largest dragon fly known to science are here reproduced only half their natural size

being large, we are unable to apply the same standards of measurement.

Now, to discuss the reason for the disappearance of the large Odonata before mentioning some of our giant living insects.

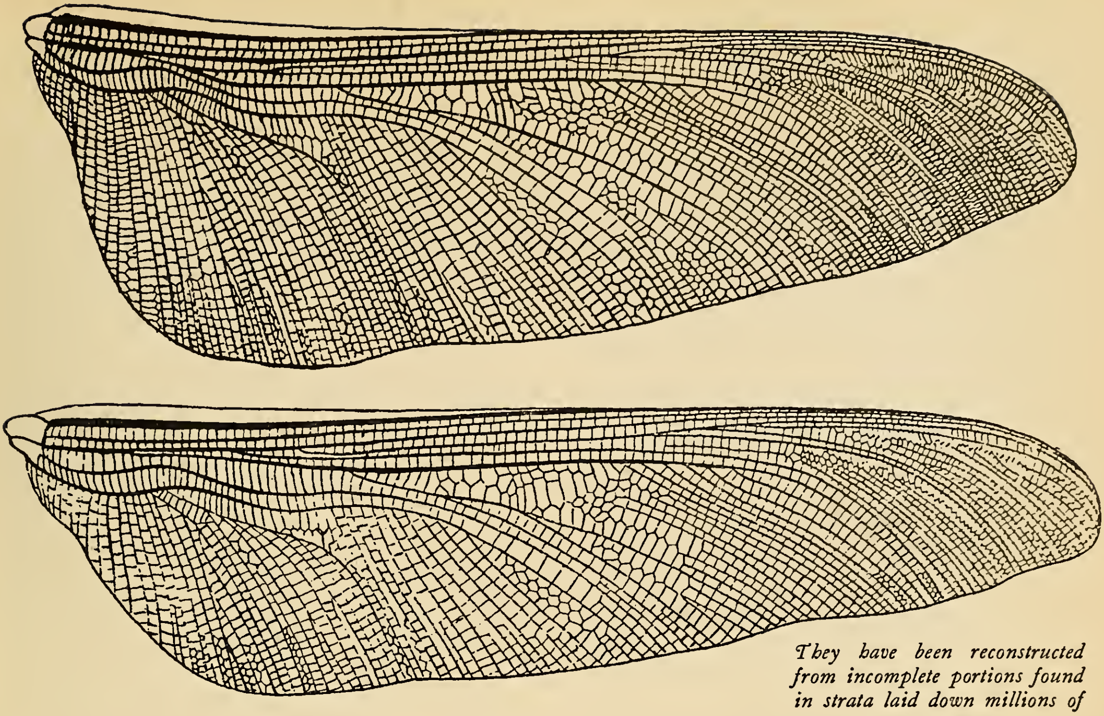
We cannot be absolutely certain of the causes of the decline in the dragon flies, but the probability is that the main reason was the lack of food. The creatures feed upon other insects in both the adult and larval stages. Since the larvæ of dragon flies are aquatic in habit, they were forced to feed upon the animal life in the ponds, lakes or rivers in which they lived, and the adults were forced to depend upon flying insects.

We cannot be at all sure as to the abundance of aquatic insects in those early days, but it is safe to say that both the larvæ and adult dragon flies made terrific inroads on the numbers of the very much smaller creatures upon which they fed.

The records do not give us any indication of other huge neuropteroid insects, whose larvæ are aquatic, and it is therefore evident that the huge nymphs of the dragon flies must have required an unbelievably large number of other nymphs in order to reach maturity and develop into the equally ravenous adults that spent their days skimming over the water, marshes, and hillsides in search of prey. It is possible that the assumption that the inability to secure food was the cause does not accurately explain the decline of these insects, but there seems to be no other very good reason, unless some sudden and widespread change in climate was responsible.

Even today the number of large insects is small and very few attain a length of more than six inches. What is probably our largest one occurs in the East Indies and belongs to the group of insects known as "walking sticks," some of which must be well known to almost everyone, since we have one or two common species of this largely tropical group even in the United States and southern Canada.

In the natural order of things these insects are not far removed from the grasshoppers and, like them, are vegetarians. Some of them are entirely wingless, while others have functional wings as shown on p. 426, the lower wings being folded so that they lie concealed beneath the small, elongate, upper ones. The largest species measures a foot in length and has a breadth of two inches, being almost twice as long and decidedly broader than the species figured. It is a spiny creature and rather ferocious in appearance although entirely harmless.



They have been reconstructed from incomplete portions found in strata laid down millions of years ago

There are several remarkable things about "walking sticks," not the least striking being their appearance. While at rest they often flatten themselves out along a twig, their front legs and antennæ stretched forward, the posterior four legs extended back. When disturbed, they move away with an ungainly gait, looking like nothing else in the world more than a walking twig — hence their common name. In flight some of them are quite beautiful since the lower wings are brightly colored in many of the species.

No one would be at all surprised to hear of a mouse eating a grasshopper, but the reverse would be considered rather sensational. Nevertheless, it is a fact and may be a more common occurrence than we imagine. In the British Museum of Natural History there is preserved a grasshopper about four inches in length, with its prey, a mouse of approximately two and one-half inches exclusive of tail. This specimen was received from Africa many years ago.

We regard grasshoppers and locusts as strictly vegetarian, but they have long been known to eat other insects, although none of them do so to the exclusion of vegetation. It is their destructive habits during their great migrations that bring them forcibly to our attention. It is said that in Africa the great hoards of these insects feeding upon foliage make so much noise that they may be heard for long distances, and that large branches of trees are snapped off by the weight of their numbers.

One of our largest American species attains a length of five inches and has the thorax and front wings spotted with yellow, the posterior wings being reddish and black.

Few of the true bugs are of large size, although some of the Cicadas, erroneously called "locusts" by many people, are large and have a considerable wing expanse. One large Fulgorid may not be larger than some of the Cicadas but there is something fascinating about the bug. Its scientific name is *Fulgora lanternaria*, and it was so named because it was believed that it gives off a light. But it is no "lantern fly." It has been called "peanut bug" and "alligator bug" on account of the shape of the great head and because toward the lower edge of this part there is a row of markings on each side vaguely suggesting the mouth of an alligator. The adult and immature stages suck sap from trees and shrubs; the nymphs are copiously clothed with a waxy secretion, as is also the abdomen of the freshly emerged adult. It is not rare in tropical America.

Butterflies, because of their large size, brilliant colors, and day-flying habits, are among the most commonly collected insects, and the impression is probably general that this group contains the largest of our six-legged creatures.

The Ornithoptera group of the genus *Papilio*, found chiefly in the East Indies, is conceded to contain the largest butterflies, the females of one species attaining a wing expanse of ten inches, although averaging less than nine. The males are much smaller and the usually brilliantly colored wings are of peculiar shape.

One unusual thing about butterflies (from the scientific, but not the popular standpoint) is that the largest species are the most sought after. Many of the Ornithopteras and Morphos are rare and very poorly represented in collections. This is partly due to the difficulty of capturing them, as they are often observed flying over the treetops, seldom coming close to the ground. Even when flying at lower levels, they are difficult to catch without injury to their wings.

Add to this the fact that some species are seldom seen in nature, and that many of the known species have never been reared, and some idea may be obtained of the reason why they are so highly prized by museums and sought after by private collectors.

Night-flying cousins of the butterflies

There are, of course, many large kinds of moths, the night-flying cousins of the butterflies. The atlas moth is a native of the Orient and, like most of the large silkworm moths, is not rare. The adults are attracted to light and may be reared easily from the egg, so that perfect specimens may be obtained without difficulty.

These large moths are not true silkworms and the manufacture of commercially profitable silk from their cocoons has never been satisfactorily accomplished. Their greatest value lies in their beauty and the pleasure derived by the thousands of people every year who rear them from cocoons and watch the wings of the adults develop from small, thick sacks, to the natural size of the fully mature moth.

Titanus giganteus is a well-named beetle, occurring in the Guianas, but an extremely rare one. Having a length of approximately seven inches and a width of almost two and one-half, it is a bulky creature. Unlike the larger mammals it is almost unknown, our own museum containing more specimens of elephants than all the museums of the world do of this beetle. It may not be rare in nature, but when we consider that there have been many collectors in the northern part of South America who would have pounced upon such a prize, it seems likely that it is either rare or has very retiring habits. However, its relatives among the long-horn beetles in other parts of America are fairly common.

Another South American beetle, *Dynastes neptunus*, attains a length of seven inches, including the horns on the thorax, and since it is a thick-bodied animal, it is actually quite large. This species and its allies, together with the African *Megasoma goliathus*, belongs to the same family as the so-called Japanese beetle, a serious pest in the region lying between New York and Washington. However, the large species are not known to be injurious.

The flies and bees cannot boast any gigantic members. The largest fly is found in South America and belongs to a family having unusual wing venation. *Mydas coerulescens* attains a length of less than two inches and is apparently the largest representative of either of these two large and important orders of insects, many of which are so important in the control of insect pests and the pollination of flowers.

It is fortunate, indeed, that there are not a great many large insects and more especially that they are not serious pests. It is easy to imagine what would happen to the world if such pests as the potato beetle, the grain weevils, and others were even half as large as *Titanus giganteus* and were still possessed of their present destructive habits. On the other hand, their large size would make them more susceptible to the attacks of their enemies, so that it is probable that nature would be not at all disturbed and things would continue as they now are.

Only one thing can be said in favor of large size for insects, and that is, if they were larger more people would be attracted to studying them and thousands upon thousands of kinds as yet unknown to science would long since have been described. But then the entomologist would be denied the joy of peering into his microscope and discovering the beauties of structure and detail possessed by some of our microscopic species.

Nature's Sea Serpent

An authentic history of the amazing "King of the Herrings" and of his encounters with Homo sapiens

By William King Gregory
Curator, Living and Extinct Fishes, American Museum

Loch Ness has its colossally successful "Monster" (with affidavits) and Vancouver its "Old Reliable," with eyewitnesses of rigid respectability. The human species (self-called *Homo sapiens*) being for the most part strongly mythophilous (as Barnum and many others have discovered), the market for bigger and better sea serpents is practically unlimited, but in a strictly scientific and presumably truthful Museum not so much can be done toward satisfying this demand. However, a Curator of Fishes may be excused perhaps for succumbing occasionally to the showman's urge and pointing with pride to one of Nature's own sea serpents, the King of the Herrings (*Regalecus glesne* Ascanius), which is known to attain the respectable length of twenty-one feet.

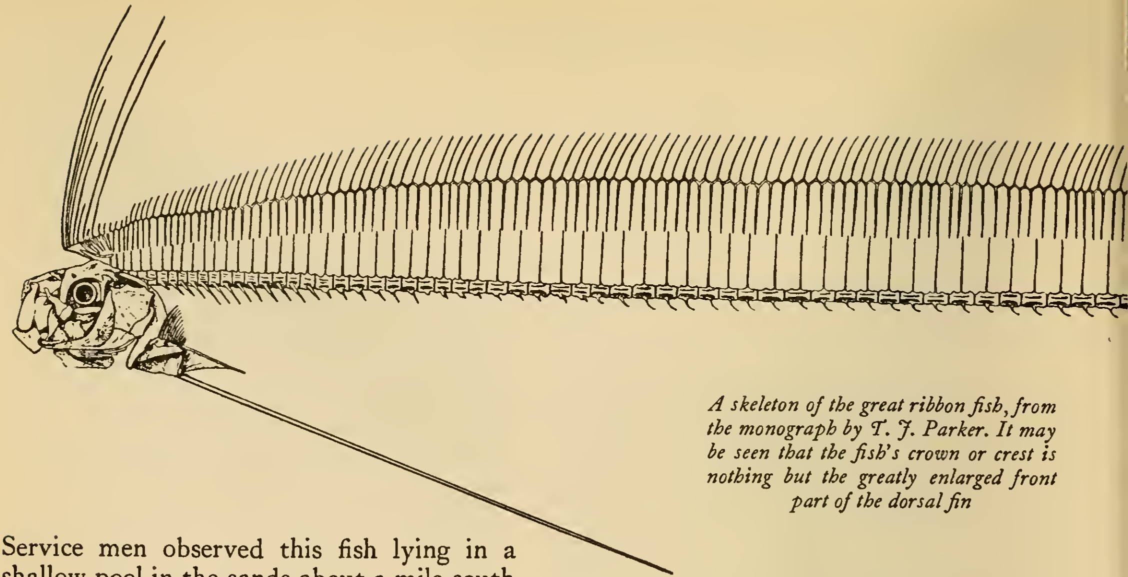
I am referring to this fish as Nature's sea serpent to distinguish him from Kipling's sea serpent, which was a damaged whale-shark, and from the Coast-of-Normandy sea serpent, which was a mutilated basking-shark, and from the Mauretania sea serpent, which seems to have been a pure *Chimaera bombitans in vacuo.*

Unlike Doctor Beebe's *Bathysphaera intacta*, that monster of the great depths that tried to disturb the privacy of the bathysphere, the unfortunate King of the Herrings has been neither "untouched" nor "untouchable." Indeed he has had his crown messed up and his person lacerated with boat hooks on the rare occasions on which he has fallen into the profane, ravaging hands of *Homo sapiens*. Listen to this excellent "Account of a Ribbon Fish (*Gymnetrus*) taken off the coast of Northumberland" as reported by Albany Hancock and Dennis Embleton, M.D., in *The Annals and Magazine of Natural History*, Second Series, No. 19, July, 1849:

"On the 26th of March, 1849, a fine specimen of a species of *Gymnetrus* or Ribbon Fish, was captured by Bartholomew Taylor and his two sons, the crew of a fishing coble belonging to Cullercoats. It was found at about six miles from shore, and in from twenty to thirty fathoms water. The men having started from their fishing ground to return homewards, observed at a little distance what appeared to be broken water; the old man being struck with such a novelty, directed his lads to pull towards it; on nearing the spot they perceived a large fish lying on its side on the top of the water. The fish as they approached it righted itself, and came with a gentle lateral undulating motion towards them, showing its crest and a small portion of the head occasionally above water; when it came alongside, one of them struck it with his picket — a hook attached to the end of a small stick, and used in landing their fish; on this it made off with a vigorous and vertical undulating motion, and disappeared, Taylor says, as quick as lightning under the surface. In a short time it reappeared at a little distance, and pulling up to it they found it again lying on its side; they plied the picket a second time, and struck it a little behind the head; the picket again tore through the tender flesh by a violent effort of the fish, which escaped once more, but with diminished vigour; on the boat coming a third time alongside, the two young men putting their arms round the fish, lifted it into the boat. Signs of life remained for some time after the fish was captured, but no doubt it was in a dying or very sickly state when first discovered by the Taylors."

But Hancock and Embleton report an even more dramatic encounter between *Regalecus* and *Homo*.

"We have lately been favoured with a letter from Mr. George Tate of Alnwick respecting a fish of this genus, from which we make the following extract: — 'A fish was exhibited in January or February of the year 1845, similar in its general form to that, a drawing of which you showed me when I was last in Newcastle. One of the Preventive



A skeleton of the great ribbon fish, from the monograph by T. J. Parker. It may be seen that the fish's crown or crest is nothing but the greatly enlarged front part of the dorsal fin

Service men observed this fish lying in a shallow pool in the sands about a mile south of Alnmouth, where it had been left by the receding tide. Its great length and unusual appearance at once raised the man's curiosity and excited his fears. On approaching it, the creature bent itself round so as to appear like the rim of a coach-wheel, and the man, supposing it was about to dart upon him, drew his sword and struck it on the head. The fish struggled much, but the man striking it repeatedly at length succeeded in cutting off its head.' "

Thus the poor sea-king lost his crown and his head.

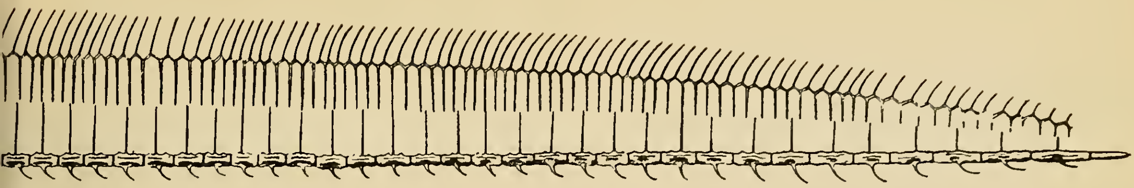
Naturally it is not until after all damage possible has been done that the local naturalist, if there be one, hears about the strange fish and hurries to the scene to study the sad remains.

"It was exhibited the same day in Tynemouth, North and South Shields," write Messrs. Hancock and Embleton, speaking of the specimen captured by the fisherman in 1849, "and brought to Newcastle next morning. In the afternoon we first saw it; we found it much injured by the strokes of the hook and by rough handling during its removals and the examinations it had undergone. The fins were a good deal torn but the fish evidently quite fresh." And then these very competent naturalists got busy and made measurements, careful dissections and a host of precise and illuminating observations, which they later combined with a fine review of the scattered literature of the subject.

A half-century later at Newport Beach on the shores of southern California a giant oarfish came too near the abodes of *Homo sapiens*. A Mexican saw it alive in the surf and afterward claimed that he hauled it ashore. "Being ignorant of its value, he cut it up, bringing in a part of the scarlet fins and a slice of the flesh. This he showed to some men and led the way to where lay the mutilated remains of one of the finest oar- or ribbon-fishes ever seen. The specimen was twenty-one feet in length and its weight estimated at about five or six hundred pounds. The finder had so mutilated it that the fish was ruined for almost any purpose." So wrote Mr. C. F. Holder as quoted by David Starr Jordan (*Fishes*, 1925, pp. 684–686).

Another ribbon fish, a small specimen, was taken alive at Avalon Bay, Santa Catalina, in the same enlightened State, but "the fortunate finder of this specimen," writes Mr. Holder, "could not be persuaded to give it up or to sell it, and it was its fate to be pasted upon a piece of board, dried in the sun as a 'curio,' where, as if in retaliation at the destruction of so rare a specimen, it soon disappeared."

So far as I have been able to discover, only two naturalists have ever had the privilege of seeing a living King of the Herrings. Mr. Holder (quoted by Jordan, p. 685) states that on one occasion a small oarfish, "not over two feet in length, was discovered swimming in shallow water along the beach of Avalon Bay [Catalina Island, southern California]. I had an opportunity to observe the radiant creature before it died. Its 'topknot' — it can be compared to nothing else



— was a vivid red or scarlet mass of seeming plumes — the dorsal fins, which merged into a long fin, extending to the tail. The color of the body was a brilliant silver sheen splashed with equally vivid black zebra-like stripes, which gave the fish a most striking appearance. The fish was a fragile and delicate creature, a very ghost of a fish, which swam along where the water gently lapped the sands with an undulatory motion, looking like one of its names—the ribbon-fish."

In 1906, in the seas of the Indo-Australian Archipelago, Prof. Frederick Wood Jones (quoted by Weber and De Beaufort in *The Fishes of the Indo-Australian Archipelago*, V, Leiden, 1929, pp. 92, 93), who was the naturalist on board a steamer that was laying a cable, saw a living *Regalecus* in all its glory.

"On October 28th, 1906, 30 miles South of the Island of Sumbawa . . . whilst the ship was hanging on to its cable, at about 10 A.M. a long and very beautiful fish came to the surface at our bows and stood with its nose close to cable, just keeping pace with the current. Baited hooks were thrown to it but it took no notice of them. Attempts were made to hook it or catch it with a running bowline, but without success. Whenever it was touched by a hook or a rope, a crest of a fine red colour was erected from the head. This crest was nearly 3 feet out of water. The fish slowly sank again but appeared later in the morning again and was at last scrambled on board a boat . . . In the water the fish was a wonderful sight. The vivid red crest and dorsal fin, and the scarlet streamers of his sides, and the blue of his head and intense shine of silver of his body making him very beautiful in the clear water. His tail end was bitten off just behind the vent; the remaining head and body measured 11 feet 9 inches (3582 mm.), it weighed 140 lbs. (ca. 63 K.), the greatest depth was 13 inches (330 mm.)."

The various popular and scientific names applied to our mysterious visitor from the depths refer either to some of its salient features or to its supposed habits. According to Shaw's *General Zoology* (1803, Vol. IV, p. 194): "This fish is said to be generally seen either preceding or accompanying the shoals of herrings in the northern seas, for which reason it is popularly known by the title of *King of the Herrings*."

The generic name *Regalecus*, credited by Jordan (*A Classification of Fishes*) to Brünnich 1771, is a combination of Latin *regalis* and *halec*, fish-sauce (herring). Jordan, however, calls the Regalecidae "Oar Fishes; Sea Serpents," reserving the name "King of the Herring" for the Trachypteridae, a nearly related family of smaller fishes.

The name *oarfish* was given in allusion to the pair of very long, strong, and straight ventral spines, which terminate in small ovate expanded tips. "Ribbon-fish" obviously refers to the extreme lateral compression of the body, which in Hancock and Embleton's specimen was only two and three-quarters inches thick in a fish twelve feet, three inches in length and eleven and one-quarter inches in maximum height.

The Japanese fishermen, according to Jordan (p. 683), call our fish the "Cock of the Palace under the Sea," in evident allusion to its brilliant recurved nuchal crest.

That the King of the Herrings may have contributed, along with other sea creatures, to the myth of the sea serpent was suggested by Hancock and Embleton (1849, pp. 15, 16) in the following passages:

"We have moreover learnt from a Norwegian captain who frequents this port and has traded to Archangel, that in the White Sea, fish closely resembling the Cullercoats one are occasionally seen, the silvery colour, long attenuated form, and rapid undulating motion being their chief characteristics. They are there called Stone Serpents.

"It has occurred at once to many here and to ourselves also on first viewing this *Gymnetrus*, that it may possibly have been taken for the famous Sea Serpent. The Archangel name of the fish seen there, strengthens the idea that it may at times have deceived the eye of some credulous mariner, from its rapid undulating motion, linear form, and from its occasionally appearing at the surface, and leaving a lengthened wake behind it, thus creating an exaggerated idea of its extent.

"On consulting however the accounts which have appeared of the Sea Serpent, we find that they relate in most instances to creatures widely different from the Ribbon Fish, such as whales, seals, sharks, etc., seen under disadvantageous circumstances or imperfectly observed. Still, though the *Gymnetrus* may not have originated the idea of the existence of a marine serpent, we think it not improbable that the occasional appearance of this fish may very materially have tended to keep up among the Norwegian fishermen that faith which they are stated to hold in the existence of such a monster."

In view of the extraordinary interest of the oarfish and in the lack of preserved specimens, which are excessively rare, we undertook some years ago to construct a life-sized model of the fish. For this purpose we selected the beautifully illustrated account of the external appearance, soft anatomy and skeleton of the New Zealand oarfish, *Regalecus argenteus*, as given by Professor T. J. Parker in 1884. This specimen was cast ashore at Moeraki near Otago, New Zealand, in June, 1883. It was twelve and one-half feet long, greatest height, fifteen and one-quarter inches, greatest thickness, three and one-half inches. Supplementary details were taken from other sources. The life-sized model was skilfully constructed and painted by Mr. Christopher Marguglio and is now exhibited in the inner room of the Hall of Fishes.

It would seem appropriate for the King of the Herrings to have a long pedigree of noble forebears, but unfortunately, Palæontology, which has supplied family trees for many less imposing personages in the fish world, has not yet revealed our hero's direct line of ancestry. Nevertheless, the proud king (not unlike *Homo sapiens* in this respect) bears in his own person some rather convincing evidences that his ancestors have not always worn a crown.

In the first place, his very crown or crest itself on close inspection is seen to be nothing but the greatly enlarged front part of the dorsal fin, and the fact that he can raise and lower this crest confirms the evidence of the skeleton that the slender rays supporting the crest are operated by erector and depressor muscles essentially like those in the dorsal fin of any yellow perch caught on a bent pin by a small boy.

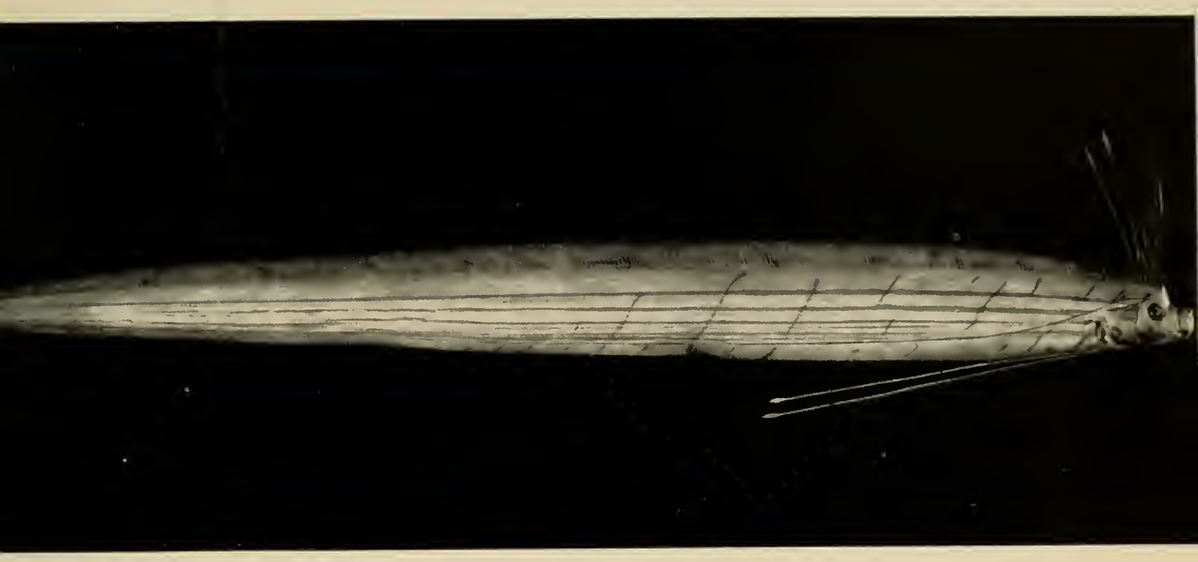
Those long and graceful "oars" on the under side of the body just behind the head are assuredly nothing but much specialized ventral fins; and the fact that they are fastened to the lower part of the collar-bone indicates that the King of the Herrings is one of the innumerable descendants of the ancestral "spiny-fin" of the Cretaceous period. These ancestral spiny-fins were not unlike the humble yellow perch in general build but with shorter bodies, rounded in side view, and a large, normal fish tail. Their mouths, supported by movable bony plates, were already protrusile.

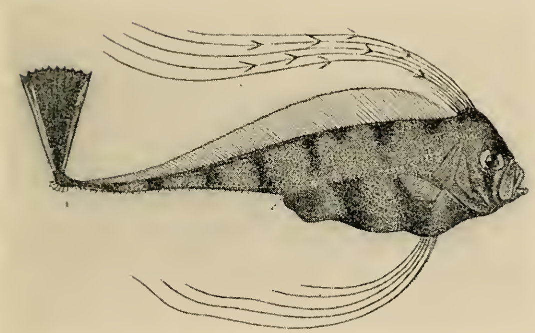
The King of the Herrings is again like *Homo sapiens* in the fact that he has some poor relations still living who would no doubt cheerfully testify to his humble derivation. Of these the lowest in rank is a fish called *Velifer hypselopterus*, who would be an ordinary-looking fish if it were not for his enormous dorsal and anal fins. Simply by multiplying the segments of the body, short-bodied fishes have often been transformed into long-bodied ones, and in *Regalecus* the great similarity of one segment to the next indicates that this is exactly what happened. The early larval deal fish indeed represents an intermediate stage in this multiplication of bony and muscular segments.

Hancock and Embleton report the presence of ovaries in their specimen and T. J. Parker says that his fish was an adult female. It is evident therefore that there is little or no scientific support either for the Norwegian name "King of the Herrings" or for the Japanese "Cock of the Palace under the Sea." To judge by analogy from the known cases of extreme sexual dimorphism in some other deep-sea fishes, it would not be surprising if the mate of the fearsome Queen of the Herrings were some insignificant shrimp of a fish only a foot or two long and resembling the dealfish (*Trachypterus*).

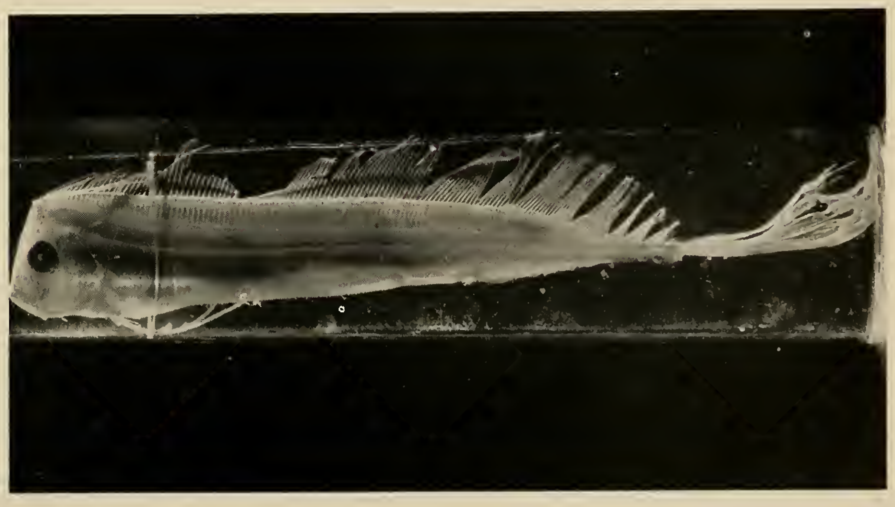
Sic transit gloria regis halecorum!

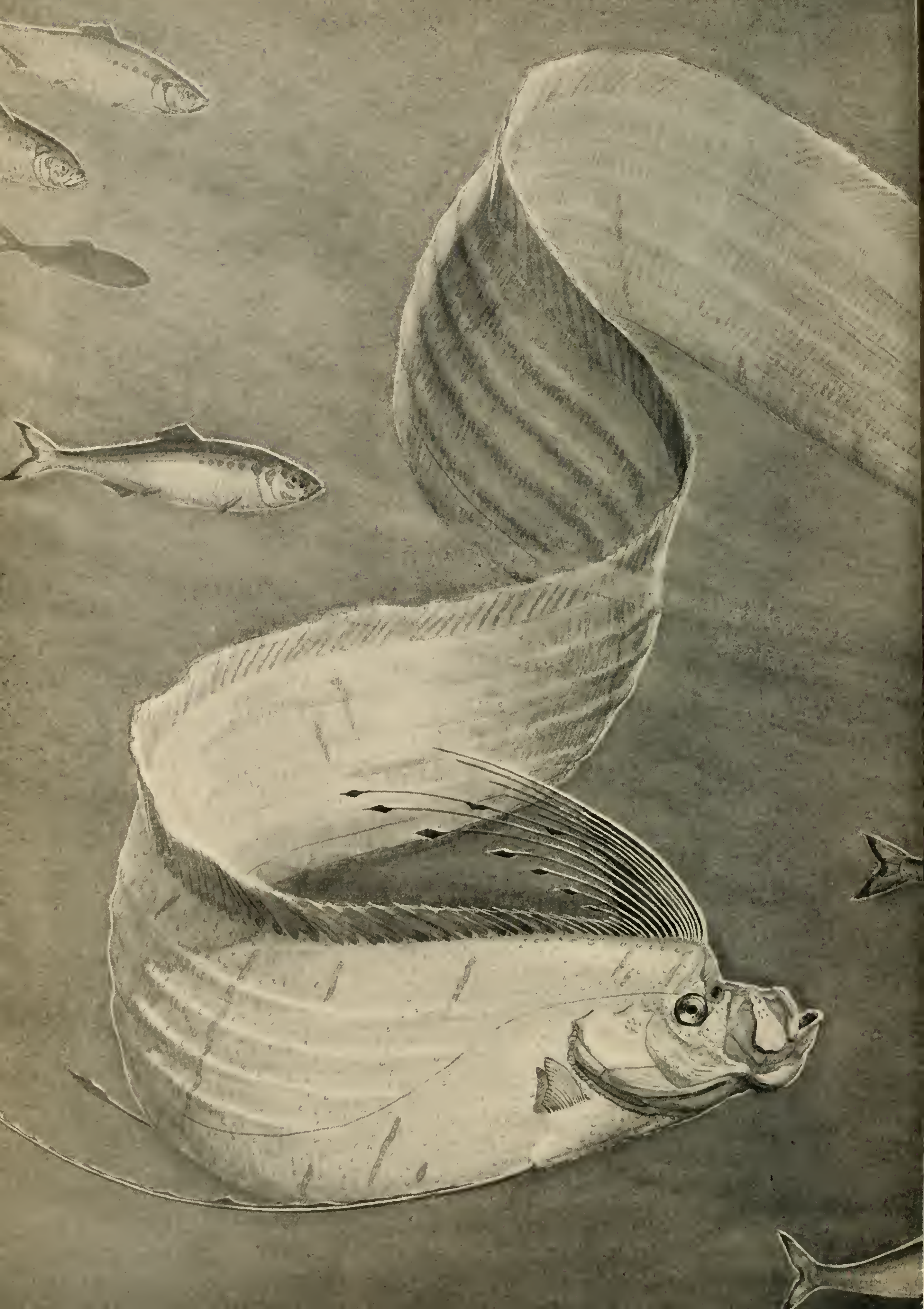
Oar and Dealfishes—Enigmas of the Sea

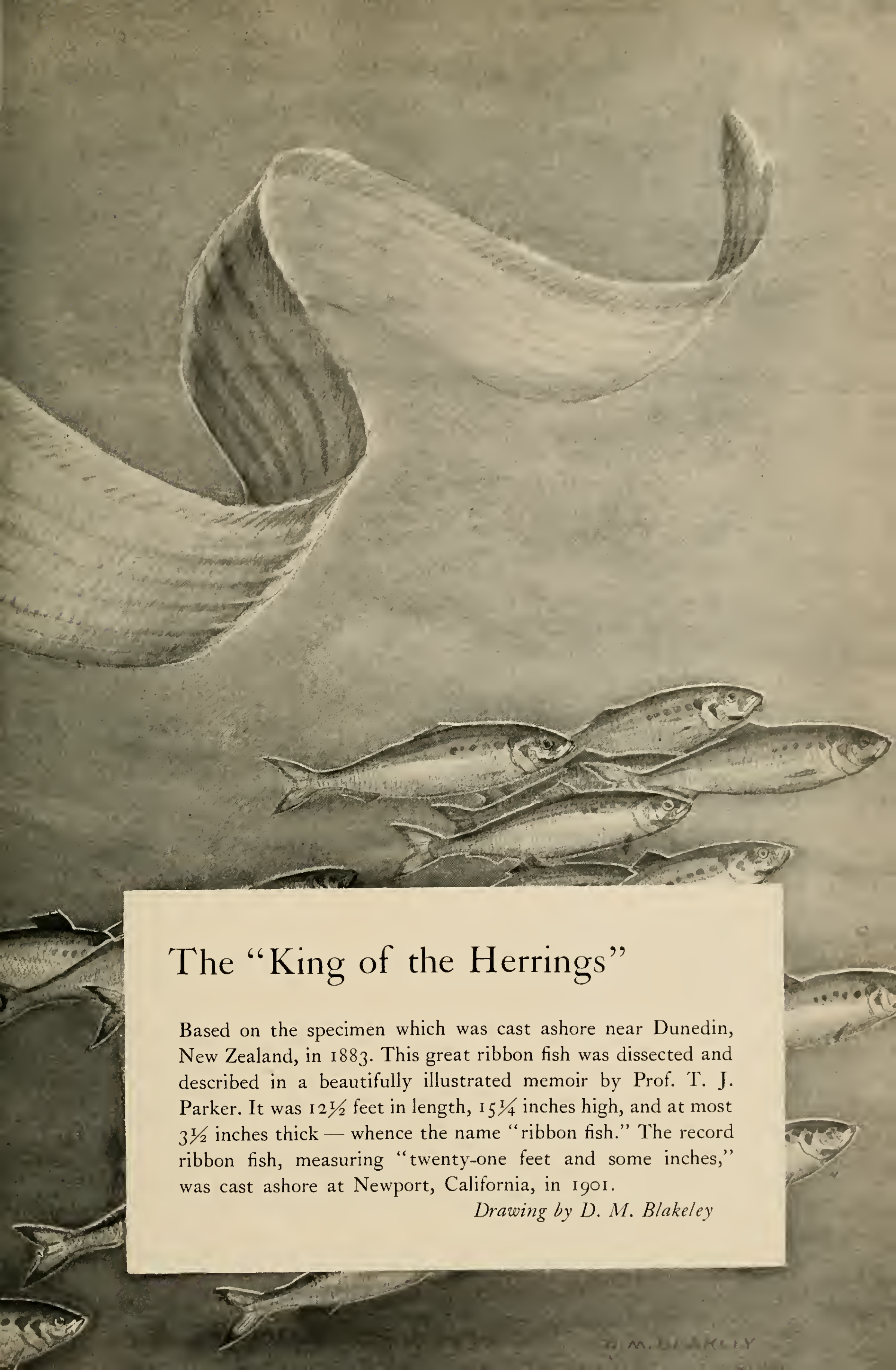




Above: Photograph of a model of the great ribbon fish on exhibition in the Hall of Fishes at the American Museum. *Left:* The larval specimen of a dealfish about six inches long. From Weber and De Beaufort. *Below:* A young "dealfish." This specimen, measuring nine inches in length (to tip of tail) was secured in Japan by the late Prof. Bashford Dean. Possibly this may be only the young or the male of the great ribbon fish







The "King of the Herrings"

Based on the specimen which was cast ashore near Dunedin, New Zealand, in 1883. This great ribbon fish was dissected and described in a beautifully illustrated memoir by Prof. T. J. Parker. It was 12½ feet in length, 15¼ inches high, and at most 3½ inches thick — whence the name "ribbon fish." The record ribbon fish, measuring "twenty-one feet and some inches," was cast ashore at Newport, California, in 1901.

Drawing by D. M. Blakeley

Science in the Field and in the Laboratory

American Museum Activities, Expeditions, Education, Meetings of Societies, and New Members

Edited by A. KATHERINE BERGER

The Cover Painting for the May Issue

The cover of this issue of NATURAL HISTORY was painted by Mr. W. L. Kihn, and represents the monolithic statues of Easter Island described in Dr. H. L. Shapiro's article on pp. 365–377. Statues, similar to those pictured on the cover, are found on the inner and outer slopes of Rano Raraku, an extinct volcanic crater on Easter Island. They range in height from 10 feet to 40 feet, and one still unquarried, but roughly blocked out, is said to be well over 60 feet in length. Except for minor details, the many statues scattered on the mountain-sides are carved to the same pattern. Their boldly cut planes throw dramatic and effective shadows which from a distance give them a reality that on closer inspection they do not possess.

The American Museum — Sinclair Expedition

Through the generous coöperation of the Sinclair Refining Company, dinosaur work was continued this year over six of the Rocky Mountain States.

The dinosaur quarry on the Barker Howe ranch, twenty-five miles northeast of Greybull, Wyoming (second only in importance to the Dinosaur National Monument of Utah), was completed and a car-load of 144 large boxes of skeleton material was shipped to the Museum.

During the first investigation of this deposit in 1932, preliminary work indicated two large skeletons. In 1933 six feet of the overlying sandstone was removed — over an area 65 x 45 feet. In June, 1934, camp was established on the Howe ranch and during the season twelve people were engaged in the excavation.

It soon became apparent that instead of two skeletons there was a mass of skeletal remains interlocked and tangled in a manner difficult to unravel. The entire deposit was first carefully uncovered and laid off in three-foot squares, given numbers, and bones accurately drawn within the squares on the quarry chart. When the bones were hardened, plastered, and excavated, each bone was given its square number, thus making definite association possible when the bones are prepared in the laboratory.

At least 4000 bones were collected, mostly of large Sauropods and Ornithischian dinosaurs with a few carnivorous teeth, patches of skin and pockets of stomach stones. There are at least three mountable composite skeletons in this collection.

These dinosaurs are Jurassic in age and represent a northern fauna 300 miles north of previously described Sauropods with several genera and at least six species new to science. More than twenty individuals are preserved, the largest approximately fifty feet long, but a *Barosaurus*-like species predominates, including one specimen with a delicate skull and jaws attached.

Although mostly broken in short sections, the bones are not badly crushed and are practically free of matrix — a condition that is of great importance in a collection of this magnitude. A force of five trained laboratory men can prepare the entire collection in three years.

As a result of the widespread publicity, thousands of visitors came during the summer from every State in the Union, some bringing information of value.

Arrangements had been made with the Sinclair Refining Company to supply an airplane which arrived September 1 and was used until October 16, during which time we flew 20,000 miles, making an aërial survey over Montana, Wyoming, South Dakota, Utah, Colorado, Arizona, and New Mexico.

The airplane opened up a new world of investigation, enabling me to trace strata and determine their relationship with a certainty not possible from the ground. We were equipped with twenty-four inch and ten-inch Fairchild aërial cameras and secured photographic records of great value.

Several new areas of extensive promising exposures were discovered in fields previously thought to be completely explored and these were immediately checked by ground survey.

New areas discovered by this method in Triassic, Jurassic, Cretaceous, and Fort Union strata will require at least three seasons for our field parties to explore completely.

Other important discoveries from this aërial reconnaissance are:

1. A quarry of dinosaur bones with twenty-five feet of bones exposed in the Mesa Verde formation (mid-Cretaceous strata in which occur the largest dinosaur tracks known and in which bones have not been found previously).
2. A fine ceratopsian skull and jaws in the Judith River formation.
3. A *Mosasaur* skeleton and a five-foot *Mosasaur* skull in the Pierre Cretaceous.
4. A new type of reptile (collected), Middle Triassic.
5. An unreported Meteoric Crater.
6. An unreported Ceremonial Way of Twelfth Century.
7. Several new oil domes. — BARNUM BROWN

Morden Expedition

Among the first few fishes sent by Mr. William J. Morden from Honolulu is a specimen of *Uraspis candens*, representing a genus allied to *Caranx* found about islands of the Pacific, and new to the collections of the American Museum. Fishes of this genus have the armature of the lateral line peculiar. They are somber-colored, with the large tongue and some space around it abruptly white, contrasting sharply with adjacent parts when the mouth is open. The presumption is that this color character is correlated with some as yet unknown habit which they possess. — J. T. N.

Snyder Canadian Expedition

On April 6 Mr. George G. Goodwin, assistant curator in the department of mammals in the American Museum, returned after a trip to Northern Alberta to collect an adult wood buffalo bull in winter pelage. Mr. Goodwin left New York on March 3 and flew in a new giant Bellanca plane, one of Canada's greatest aircraft machines, from Wilmington, Delaware, to the Government Hay Camp near Fort Smith in Northern Alberta.

Accompanied by Mike Dempsey, forest ranger, he traveled two days out in the bush with dog teams to the range of the buffalo and hunted on snow shoes. The animals were extremely wary and difficult to approach at this time of the year. Travel was slow and tedious on the soft drifting snow, yet the buffalo ploughed through it at full gallop.

A big bull measuring 6 feet 7 inches at the shoulder was secured by Mr. Goodwin. One thing that struck him most forcibly was the splendid condition of the animal, despite the fact that it had endured a long, hard winter, and forage was buried four feet under the snow. The temperature during the trip ranged between 30° and 40° below zero, and the hide froze as it was peeled off the animal. As is usually the case, the kill was made at dusk, and the animal was taken care of by the light of blazing logs. A blizzard, raging at sixty miles an hour with blinding snow, lasted four days during the trip.

This expedition was a continuation of Mr. Harry Snyder's expedition last fall to secure two groups of wood buffalo, one of which is to be mounted and donated by Mr. Snyder to the Victoria Museum at Ottawa.

The Hispaniola Expedition

Mr. William G. Hassler who is leading an expedition to Hispaniola on funds provided by Miss Maud Lewis Fletcher, writes that he has successfully landed his equipment in Haiti and is rapidly becoming settled near St. Marc. The expedition is provided with a ton and a half Chevrolet truck, which will make it possible to move rapidly from one part of Hispaniola to another. Although the American Museum has had several previous expeditions in Hispaniola, this is the first time a truck has been imported solely for natural history studies.

Amateur Astronomers Association

During the month of May the Amateur Astronomers Association will present the following radio talks over Station WOR, on Tuesdays at the usual time, 3:30 P.M.

May 7 — Subject to be announced — John J. O'Neill, Science Editor of the *N. Y. Herald Tribune*
May 14 — Recent Books on Astronomy — Marian Lockwood
May 21 — Mercury — Hugh S. Rice
May 28 — The Asteroids — Hugh S. Rice

The last two meetings of the Association for the current season will be held this month, Wednesday, May 1, at 8:15 P.M., being the Annual Meeting with election of officers. Astronomical motion pictures will be shown.

The Hayden Planetarium

As NATURAL HISTORY goes to press the stainless steel inner dome of the Planetarium is almost completed.

BUFFALO CROSSING THE SLAVE RIVER, CANADA

These animals survive severe cold with little apparent discomfort, and plough through the deep snow with great ease. The temperature in the region frequently falls to 60 degrees below zero

The lower row of plates, with the cut-out of the sky line of New York City as seen from Central Park, is already in place. This sky line is not painted on the dome, as many people think, but is actually cut out of the stainless steel. In back of it is placed a black background which makes the silhouette stand out clearly. The dome still has to be painted its final white color.

Planet Notes for May

Venus continues to be the evening star in the western sky, setting about 10:30 at the middle of the month. On May 5 there is an interesting close conjunction between Venus and the moon, which in some localities will be an occultation. During May the planet Mars is in the constellation Virgo, near the bright star Spica. The fact that the two planets, Venus and Mars, are both in the evening sky at the same time, Venus in the west and Mars in the east, makes the heavens particularly interesting at this time. Jupiter appears later in the evening in the constellation Libra.

Phases of the Moon

May 2, New Moon; May 10, First Quarter; May 18, Full Moon; May 25, Last Quarter.

Astronomical Gleanings

The new star, Nova Herculis, which flashed into prominence last December, becoming one of the dozen brightest stars, has sunk below naked-eye visibility. On April 1st it suddenly went from mag. 4.5 to mag. 6, and since then has fallen to mag. 7. . . . The moon produces tides in the solid earth similar to those that it produces in the oceans, alternately drawing Europe and this continent together and pulling them apart. This continental shift, now verified, has a range of about 63 feet. . . . A new spiral nebula has been discovered so distant that its light has been traveling 500 million years to reach the earth. This spiral — for the moment — is the most distant object ever observed.

Experimental Biology

Dr. G. K. Noble recently addressed the biological seminar of Princeton University on the relation of the sense organs to the social behavior of reptiles.

Living Reptiles and Amphibians at the American Museum

The innovation of placing live reptiles and amphibians in the reptile hall of the American Museum has proved so successful that a semi-permanent installation has been made at the far end of the hall. Here specimens of striking biological interest will be displayed with a proper setting of living plants. The new greenhouse in the Museum serves as a source of supply for both living animals and living plants.

Appointments

At a meeting of the Executive Committee of the American Museum on March 21 Mr. Roswell Miller, Jr., was appointed field associate in the department of living invertebrates for the year 1935, in appreciation of his active participation in the expedition of the department of living invertebrates to the Bahamas in 1933, the collections made by him on his expeditions to the Society Islands in 1934, and his present purpose of collecting and making observations of marine life in Jamaica during the current year.

A Flower Calendar for May in Bronx Park

For flower lovers in the vicinity of New York, the New York Botanical Garden is promising that spring wild flowers will be blooming about May 1, throughout the natural woods which border the Bronx River. A week or so later there will be dwarf iris and other spring garden flowers in special planting on the iris slope in the southeastern section of the Garden, also in the Thompson Memorial Rock Garden; and during the latter half of May the main part of the iris display will begin to come into bloom. It will be at its best about from May 28 to June 8. Japanese cherry blossoms should be in bloom about May 20, on a knoll in the northeast part of the grounds, and a few days later lilacs in a special border south of the Rose Garden just off Pelham Parkway. Of these there are several hundred bushes in eighty-five varieties.

During May and June the innumerable flowers in the Thompson Memorial Rock Garden will be making an unprecedented display. The aim of this rock garden is to show every possible variety of rock-garden plant in its most suitable situation, both as to culture and appearance.

Lake Malheur Bird Refuge

Federal administration of the Lake Malheur Bird Refuge in Harney County, Ore., will no longer be complicated by claims that lands within the refuge are owned by the State. A recent decision by the Supreme Court of the United States, says the U. S. Biological Survey, quiets title and rejects claims asserted by the State of Oregon.

Established in 1908 by executive order of Theodore Roosevelt, the Malheur refuge has been continuously administered by the Biological Survey for the benefit of ducks, geese, swans, and other water-loving birds. By laws passed in 1917 and in subsequent years, however, the State asserted title to the beds of navigable lakes, and declared all meandered lakes to be navigable. This included Lake Malheur although this lake has never been regarded as useful for navigation.

These statutes and claims based upon them so embarrassed the Biological Survey in its relations with the many settlers permissively cutting hay and grazing stock within the refuge that the Government brought suit in the U. S. Supreme Court against the State to quiet title to the lands.

A special master to whom the controversy was referred found that title to the area did not vest in the State under its navigability claim, and also that the United States had not abandoned any lands to the State because of the running of survey lines and the issuance of patents to adjacent lands. The Supreme Court, in an opinion delivered April 1 by Justice Stone, accepted these findings.

This decision, says the Biological Survey, will simplify administration of the refuge and will also clear the way for Federal developments in connection with the Bureau's program of wildlife restoration. With the recently acquired P-ranch holdings on the Donner und Blitzen River, a tributary of Lake Malheur, and with other lands being acquired there, the refuge will be part of a large area that will once again furnish an important annual contribution to the Nation's supply of waterfowl and other wildlife.

Reviews of New Books

Recent Publications for Those Interested in Nature

The Nature of a Bird's World. By Eliot Howard. Cambridge; at the University Press. New York; the Macmillan Company 1935. $2.50.

IN THIS little volume Mr. Howard, who needs no introduction to students of bird behavior, brings together some of his observations on the activities of birds which he interprets in various ways. He objects to the term "instinct" as too often connoting an extraneous agent that impels the living organism to react in certain ways. Yet it may be doubted if this has caused much real confusion, and the reader may proceed with the book as an exposition of some very interesting instinctive actions of birds.

It is maintained that the seasonal changes in the gonads modify or alter the individual's responses to certain stimuli not always directly connected with sexual activities. Thus, a waterhen one day is seen to pick up nesting material, but only to drop it; a later day she may pick it up and start the construction of a nest which she does not finish, although she may go on to build other half completed structures; still later she returns to complete the original nest. Howard believes that a sensory stimulus, such as the sight of the building material, produces certain reactions which the bird is unable to carry through to completion until its physical condition has reached the proper stage. The nest must be finished when there are eggs ready to be laid in it, but not long in advance, and a nice timing may be the result of such conditioned instincts.

When certain activities are being carried on by the bird, each of these in turn may hold the field, during the duration of its own rhythm, as a "master reaction." This will not normally be upset by other reactions, although if the stimuli for these others are presented there may be one or more "false reactions" which are not completed. A false reaction may interrupt, for a moment, the course of the master reaction or may follow it; in the former case, it will not be completed, but in the latter case, it may itself become a master reaction. One form of behavior, however, is not the actual cause of the other. The author believes that the activity of one reaction may lower the threshold of the others so that the bird is made more sensitive to all stimulation. The form of stimulus received from objects extraneous to the body is thus in part determined by the body.

A bird's life appears to be partitioned among different worlds, such as the sexual world, the nesting world, the brooding world, etc., and each possesses its own reactions. Howard moved a nest of newly hatched young yellow buntings four inches from its original site; the hen fed the young and brooded them, though at intervals she visited the original, now empty, site. The nest was then returned to its original position, a second nest was placed beside it, the young were transferred to the second nest and blown eggs were placed in the original one. The hen abandoned the young and brooded the empty eggs in the old nest, being influenced, possibly, by the internal stimulus of habit rather than by the external one of the sight of her exposed young a few inches away. With food in her beak, however, she fed the young in the second nest, but when they were fed, she was unable to brood them but returned to brood the empty eggs. The nesting site took command of the brooding instinct; the young, of the feeding instinct. When she brooded and when she fed the nestlings she appeared to live in different worlds.

Although a bird enters life able to do things which it never needs to learn, and could not learn, it does learn many things from experience, some of which would seem to bind it to a sort of ordered routine, although this routine is not permanently fixed. Repetition undoubtedly "teaches" the bird certain procedures which it may follow or attempt to follow, even under unfavorable conditions, but the bird continually meets new problems and, as these are overcome, new "pathways" are set up; thus, though they are remembered, the "learned" reactions do not become master ones and constant change is the order rather than constant blind repetition.

Touching on the favorite topic of "territory," the author finds that the duration, size, and position of territory are provided for in each bird's inherited organization, but shape is individual. The boundaries are determined not by preference for special kinds of objects, but rather by particular chosen landmarks.

These are but samples of the many observations made by the author in his illuminating volume. It is unnecessary here to mention all the facts and theories which he has presented, or to discuss any of them in detail. The interested reader will find many suggestive questions, even though he may not agree with all of the given answers. The book may be recommended as highly stimulating to all students of bird behavior.

—J. T. Z.

Infants of the Zoo. By E. G. Boulenger, New York; E. P. Dutton & Company, 1935. 144 pp. $2.50.

THIS attractive book, written and illustrated especially for children, will also delight grown-ups who enjoy excellent photographs of young animals. Mr. Boulenger, in his foreword says:

"The charm of youth is so universal and so irresistible that it needs little elaboration. The judge and the felon, the prince and the pauper — all are equally likable in the cradle or the toddling stages of their careers. Much the same applies to the so-called lower animals. Some of the largest and most dangeous animals are so helpless and lovable in their early days, that the average man might well be excused for wishing to add them to his household pets."

In glancing through the pages of this book one can well understand that the young of certain "dangerous" animals might well appeal to those who wish to have wild pets in their homes. The young of the lion and of the tiger as presented in these pictures, would certainly seem to be outstanding "material" for home guests.

In operating our small zoo at the Bear Mountain Trailside Museum, we have long since grown to appreci-

A Playful Tiger Cub

One of the charming studies of young animals illustrating E. G. Boulenger's new book "Infants of the Zoo"

ate the fact that infant animals usually attract far more attention than their parents. This is especially true in regard to the Virginia deer fauns, to young raccoons, and even to our young skunks. For this reason, as each spring advances, we endeavor to secure young animals for exhibitional purposes. We are never disappointed in the public response to our efforts. Recently there have been a number of children's animal picture books published, and Mr. Boulenger has reached the first rank.

The greater number of the mammal photographs are by F. W. Bond and D. Seth-Smith, who are to be congratulated on their photographic ability. The descriptive texts, accompanying each photograph, are interestingly written and contain useful information. One wishes that they might have been somewhat extended in length.

In addition to the mammals there are also pictures of birds, reptiles, amphibians, and fish. Here, once more, we have evidence of Mr. Boulenger's ability in presenting and describing youthful wild subjects. Perhaps the photograph of the crowned lap-wing chick is the most original.

We are certain that this book will be received gratefully by many persons. — W. H. C.

Tropical Fishes for the Home. Their Care and Propagation. By F. H. Stoye. Carl Mertens. New York, 1935. 284 pp. 167 plates. Price $4.00.

Tropical Fishes and Home Aquaria. By Alfred Morgan. Charles Scribner's Sons. New York, 1935. 254 pp. Drawings and Photographs. Price $2.50.

There is little choice between these two attractively presented handbooks for the amateur aquarist. They both contain the necessary practical information and advice about the set-up of tanks, problems of light, air, pH, diseases, as well as short discussions of some of the more popular or more interesting tropical aquarium fishes.

Mr. Stoye's book, *Tropical Fishes for the Home*, includes a classification of the fishes with which he is dealing, made by a leading scientific authority. It is copiously illustrated, but it is regrettable, considering the way in which the black and white and color plates are massed at the back of the book, that there is no index to the illustrations. The greater number of his pictures have long been familiar to us through Rachow's *Catalogue* of 1927.

Mr. Morgan's book, *Tropical Fishes and Home Aquaria*, includes an explanation of scientific names and a directory of aquarium societies. His publisher has done well by him, both in the striking gold and green jacket of his book, and in the fine full-page reproductions of New York Aquarium photographs, many of which have also been familiar to us for some time through Coates' 1933 book on the same subject. The drawings in the Morgan book are not so happy, betraying a lack of knowledge of the external anatomy of a fish, particularly around the head and mouth parts and the lateral line, which features are important in classification. This is rather inexplicable in view of the author's twelve-page discussion on the "inside and outside of a fish" in the beginning of his book.

The "blurb" on the jacket of Mr. Morgan's book, for which I suppose he should not be held altogether responsible, is rather misleading in its implication that this is the first book of the kind, which is by no means true.

The two books are of about equal length, but Stoye gives information about a greater number of species, and his book leaves the impression that either he has put in more hard work in its preparation, or knows more about the subject. Both books dwell rather too much on color descriptions, at the expense of practical advice or information. As handbooks, both are somewhat too long, and Mr. Stoye's book is insecurely bound.

Any amateur who is taking up this hobby to any extent is bound to get his most valuable information through conversation or correspondence with other amateurs, dealers, and professional aquarium men. He can buy one good book which will give him general directions and a few hints about what is desirable and why, and can gather the rest of his information from his own observations, plus the above sources. Or, he can buy all the books available, any one of which necessarily repeats some of the information to be found in those of an earlier vintage. In the latter event, unless the last three or four years are no forecast of the future, he will eventually have quite a good-sized library on this fascinating subject.

The feature that remains to be included in one of these books is a series of really good, accurate drawings. The drawings and color plates used by Rachow and in the Blätter für Aquarien- und Terrarien-Kunde, and the New York Aquarium photographs have nearly all been used at least twice, and all have been copied, with or without acknowledgment, more than twice. Drawings showing the diagnostic characters correctly, as well as the beauty of the fish, would be not only ornamental to the book, but of real use to amateurs, professionals, and systematic ichthyologists. — F. LaMonte

Identification of the Commercial Timbers of the United States. By Brown, Harry P. and Alexis J. Panshin. McGraw Hill Book Company, Inc., New York, N. Y.

This book of 223 pages is evidently intended as a practical guide to the woods as found in commerce, rather than as a text book, such as Record's similar volume evidently is. In the introductory pages, the discussion is rather technical, and the glossary at the back will need to be frequently consulted. Further, the authors give less weight to odor and taste than the review, and the keys to naked-eye identification do not emphasize the characteristic odor of thread spools in birch, the equally evident smell of white pine, and many others. In cypress this is so pronounced that a fossil specimen was easily identified without close inspection by its odor — and it was thousands of years old! But the anatomical keys, to both gross characters and minute ones, and the very fine illustrations accompanying them, with the detailed descriptive text for each species, more than make up for these omissions, and the sources of smell and taste are so variable in different individuals that perhaps the authors are wise in keeping to more generally dependable characters for sure identification.

The book is a thoroughly practical one and will fill a real need. — Forman T. McLean, New York Botanical Garden

Men, Mirrors, and Stars. By G. Edward Pendray, 339 pp., Funk & Wagnalls Co., $3.00.

Men, Mirrors, and Stars is a book written by a man who feels, and who is able to impart to the reader his feeling, that the story of the conquest of space by astronomers is a thrilling epic. Mr. Pendray is the science editor of *The Literary Digest* and the president of the American Rocket Society. In this book he tells the history of the making of astronomy — one could truly call it that — the history of man's efforts to create instruments, and the story of the instruments themselves which have enabled man to discover more and more about this universe in which he lives.

Men, Mirrors, and Stars is divided conveniently into three main sections — the first on "How Men Became Acquainted with the Universe," the second on "Revealing the Instruments that Reveal the Stars," and the third on "Modern Men and Modern Mirrors." Then, in addition, there are two valuable appendices which list the world's largest telescopes and their locations, and the more important of the modern observatories in North America and the Southern Hemisphere, with their equipment and staffs. These appendices are particularly useful, because such information as they contain has been most difficult to find collected in handy form.

The first section deals with the subject of the early instruments which men used in studying the stars, the invention of the first telescopes, and their development through the years. In fact, this section takes the subject through to the time of the modern telescope and today's developments. The second section deals with the construction and the principles of the telescope of today; it gives you the story of the message of light in a fascinating form, and as simply as possible; it tells you the story of the "modern art of making telescopes," and describes also the instruments which supplement and measure what the telescope sees for us. The third part deals with the telescopes of today, — introducing you personally to these wonderful instruments and to their famous makers. Here you meet intimately such people as Alvan G. Clark, John A. Brashear, and Prof. Y. W. Ritchey. You read the story of the great 200-inch which is now being built, the mirror for which was but recently poured at Corning, N. Y. You learn what astronomers hope for from this great new eye that is to peer out so far into space. And then, of course, as one would expect from a man like Mr. Pendray, who, in his work on rockets, has been so occupied with thoughts of the future, there is a chapter on what we may look for in the way of greater developments, both in instruments and interplanetary travel. This book also contains many practical and helpful suggestions for amateur owners of telescopes. — Marian Lockwood

Holiday Shore. By Edith M. Patch and Carroll Lane Fenton. The Macmillan Co. New York. $2.00

This is a seaside natural history for children. It is attractively gotten up and the text is adapted for the youngsters who are likely to be playing around between the tides during summer vacation times on either the Atlantic or Pacific coasts of the United States. It is full of information which will answer the questions occurring to the minds of young naturalists. It is well illustrated by photographs, many of which were furnished by the American Museum of Natural History, and by excellent drawings by Doctor Fenton. A number of the photographs, and also of the drawings, were made from details of the invertebrate groups in the Darwin Hall of the Museum, so that the book forms an excellent supplement to the exhibits in that hall, adapted to the use of the juvenile visitor. Most of the information is quite accurate; the most noticeable mistakes, to the reviewer, are the following:

The caption for the illustration on page 3, which is entitled "The Pink Jellyfish," is incorrect. The illustration is drawn from a model of the *Dactylometra quinquecirrha*, which is found from time to time along the coast and especially in the upper reaches of Narragansett Bay. The popular name "pink jellyfish" is applied to *Cyanea arctica* and it is obvious from the text that this is the jellyfish referred to. It occurs in vast numbers along the New England coast in the latter part of the summer, together with the white jellyfish, *Aurelia flavidula*. The former of these two species is the one which is so bothersome to swimmers, and its appearance is very different from that illustrated in the book. It is unfortunate that this should not have received emphasis, rather than the much rarer *Dactylometra*, as it is the species which the small wanderer by the seashore should strive to avoid.

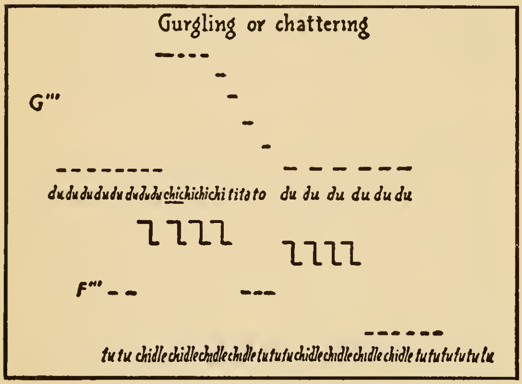
The illustration of Sepia, the cuttlefish, was made apparently from a preserved specimen, as in life the two long tentacular arms are retracted into pouches, where they are concealed, and are shot out with much vigor only when capturing prey. The outer arms of living Sepia also have broad expansions, while the body is beautifully marked with brown and yellow tiger-like stripings.

Except for these minor errors, the book is an excellent production, and forms a useful addition to juvenile nature literature. — ROY WALDO MINER

A Guide to Bird Song. By Aretas A. Saunders. D. Appleton-Century Company. New York — London, 1935. With 163 song diagrams. 285 pages.

For twenty years Mr. Saunders has been pursuing his careful study of bird song; meticulously jotting down, according to a code of his own invention, the innumerable variations of the songsters of Northeastern North America. He now presents the results of this arduous and patient, but no doubt enjoyable, field research so that all may reap the benefit.

Five factors go into the song of a bird; time, pitch, loudness, quality, and phonetics. In the author's diagrams of bird songs the first three are represented by symbols, the fourth and fifth by the written word and syllabification respectively. Thus in these graphic bird song records, the horizontal length represents the duration of a note or a pause between notes. The vertical distance obviously illustrates pitch. The higher a note, the nearer it is to the top of the diagram. Without having the limitations of the musical staff, the author is able to represent graphically the many and often minute changes in pitch so common in bird song. The volume of a note or phrase is quite logically shown by the varying heaviness or lightness of the line. Quality or timbre is more difficult, but Mr. Saunders meets this obstacle by heading the song or part of it with a few simple descriptive words, such as "Gurgling or Chattering," in the case of the house wren, and for the veery, "Weird, reedy liquid whistle." Last is phonetics. This is perhaps the hardest factor in bird song to describe, for observers rarely agree on what a bird seems to be saying. No two pairs of human ears hear exactly the same; no two persons construe identically what they hear. The author's interpretations are carefully and well worked out; they should be as helpful as any phonetic interpretations can be.


Gurgling or chattering
G'''
dududududu dududu chichichichi titato du du du du du du
F'''
tu tu chidle chidle chidle chidle tututu chidle chidle chidle chidle tutututututu

Song of the House Wren from "A Guide to Bird Song," *by Aretas A. Saunders*

This should be a most useful book. It is unique among American ornithological handbooks, and should be of as great value to the American bird student as A. Voigt's *Excursionbuch Zum Studium der Vogelstimmen* is to the German student. The European author has also developed his code, similar to, but not the same as Mr. Saunders', and it has proved a great boon to German ornithological beginners. — A. R. B.

Bird Stamps of all Countries With a Natural History of Each Bird. Grosset and Dunlap. 1935.

This volume is designed to supply an album for young stamp collectors, with spaces for all postage stamps of the world that contain portraits of birds. It also purports to name the birds thus pictured and to give some facts of natural history about each of them. The idea is excellent and a well prepared book of this sort would serve a very useful purpose. Unfortunately, the present volume has been put together without a proper amount of care and the result is far from satisfactory.

Philatelically, the book is reasonably complete, although there are some omissions, largely those of successive series of certain designs. It is with the natural history of the album that the greatest fault may be found.

In the first place, there is sometimes little effort to name the birds pictured on the stamps except in very general terms, and occasionally the names given are wrong. The "ducks" on the Newfoundland stamp of 1933 are really ptarmigans, probably Allen's ptarmigan. The Tonga stamp of 1897 is placed under the general heading of the "Kea and Kaka" but it figures the Tabuan parrot, a quite different bird.

It is impossible to find any system of arrangement used for the birds, either alphabetical or according to their relationships, and members of related groups are frequently far apart. The text is a curious mixture of fact and fiction. Much of it is correct, but there are many half truths and misconceptions scattered throughout the account which are bound to be misleading to the general reader. A few examples of these misstatements may be corrected as follows:

The cassowary is not of the ostrich family. The color of the spoonbill does not vary according to its habitat. The dodo is not so well known as it might be. The general color of all pigeons is not bluish. The kookaburra is not a cuckoo but a kingfisher and there are other species of both families which reach Australia. The wrybill is not different in coloration on its two sides. The egret is not protected because removing the plumes from its back will kill the bird, but because the bird grows these plumes only during the breeding season and because it is difficult to obtain the plumes except by killing the bird. All geese are not larger than ducks. The dovekie is neither a dove nor a black guillemot.

These are only a few of the many similar mistakes that occur throughout the text. Since the book presumably was designed with a view toward its educational possibilities, it is regrettable that more accuracy is not present in the statements. — J. T. Z.

Recent American Museum Publications

NOVITATES

No. 784. Fishes from Rio Jurua and Rio Purus, Brazilian Amazonas. By F. R. La Monte.

No. 785. Studies of Peruvian Birds. XVII. Notes on the Genera *Syndactyla*, *Anabacerthia*, *Philydor*, and *Automolus*. By John T. Zimmer.

No. 786. A New Species of *Edessa* from Puerto Rico (Family Pentatomidae). By H. G. Barber.

No. 787. A Revised Restoration of the Skeleton of *Baluchitherium*, Gigantic Fossil Rhinoceros of Central Asia. By Walter Granger and William K. Gregory.

Recently Elected Members

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum:

Benefactor

Mr. Arthur Stannard Vernay.

Associate Benefactors

Doctor Harvey Bassler.
Mr. Templeton Crocker.

Fellows

Messrs. William D. Campbell, Lamar Hardy, William Procter, David Rockefeller.

Honorary Life Members

Misses Ida Richardson Hood, Mabel Rice Percy.
Messrs. Cass Canfield, Thomas Davin, Robert Johnson, Arthur Page.

Life Member

Doctor Felipe Ovalle Q.

Annual Members

Mesdames Leo Frenkel, J. H. Van Alstyne, Robt. N. Warmack.
Doctor Henry James.
Messrs. Lewis A. Beardsley, Arthur L. Cone, Jr., A. M. Fellows, E. H. Foster, Langdon Roosevelt Geer, Ralph W. Gwinn, E. Sperry Lea, Thomas James Lengyel, Roy M. Meiklejohn, Vernon Munroe, John Patton Ogden, Albert H. Smith, William H. Stuart, Walter F. Wells, M. O. Williams, W. Howard Wise, William H. Wright, Jr., Rudolf Zimmer.

Associate Members

Mesdames Vinnie Ream Aborn, Jos. F. Adelmeyer, Durand C. Alexander, Milton Alpern, Gladys F. Amstutz, Christian S. Andersen, Viola P. Anderson, J. Winthrop Andrews, Maud Haskell Antholz, W. S. Applegate, Frank J. Argersinger, Curtis Arnen, W. H. Arnold, Gertrude Atherton, Gertrude B. Austin.

Sara L. Bach, Alfred Baldwin, Blaizie L. Bamberg, Mary E. Barker, Elizabeth Coyle Barber, Pauline A. Bashkowitz, R. A. D. Beaty, J. K. Bedell, Louis R. Bennett, Wray A. Bentley, Margaret C. Berardinelli, Alice D. Bergenthal, Eva Berkowitz, H. Lurie Berlin, T. Howard Biddy, Sam Birndorf, Hannah Bjorlin, J. R. Blackstock, Bessie M. Bloch, R. W. Blosser, Mabel F. Bogart, Edward H. Booth, Aimee Bournat, E. J. Brandt, Mary Warner Brenton, Charles Brickell, Albert M. Briggs, V. May Bristol, Goudyloch Saffold Browne, S. B. Browne, Dorothy Burnham-Rose, Virginia B. Burr, Nellie E. Byrne.

Murray A. Cain, Henrietta A. Campbell, Mary R. Carey, Alice M. Carpenter, Barbara J. Carpenter, M. Estelle Carter, Xenia Casement, Alice W. Chapman, Daniel K. Chapman, Fred D. Chapman, J. Crosby Chapman, Harry Woodburn Chase, Dorothy K. Chute, Charles Heber Clark, Cyrus Clark, Warren A. Clark, J. L. Cleveland, Jr., Paul E. Coil, A. D. Cole, Juliet A. Cole, Spencer Allen Collom, Sr., L. R. Combs, C. A. Conard, Hulda R. Conklin, Chesley W. Cook, Edward M. Cook, Harris A. Corell, Nellie B. Corrigan, Frank S. Cragin, Mary Heine Craggs, Miner D. Crary, Marian M. Crowley, J. E. Cummings, Andrew C. Cunningham, A. C. Curtis, W. L. Curtis, J. E. Cushing, Evelyn Roeding Cuttle.

W. S. Davidson, C. L. Davis, Emma J. Dawson, John Henry Dean, Frederick Deane, Olivette P. Dennison, John R. Dershuck, Ethel E. Deutsch, Walter A. Dew, Adelaide De Zeller, Mary Little Dice, Erma R. Dixon, C. E. Dodd, A. Wilson Dods, H. W. Dorsett, Fred B. Dunn, William McKee Dunn, Aveline A. Dyer.

L. B. Edwards, Pearl Huber Elsner, Charles A. Emise, Ethel I. Englund, Mary C. Ewing, Thomas Ewing.

John L. Farwell, Louis M. Faulkner, Mary Van E. Ferguson, Grace D. Fessenden, Jean S. Finney, Gertrude F. Fleming, Waldo E. Forbes, Aldyth C. Fox, Vivien P. Frank, E. F. Fredericks, A. R. Frostenson, Otto W. Fuhrmann.

Ella L. Galloway, Cary B. Gamble, Lilian Garis, Laura C. Gilbert, Lucretia C. Gilbert, Eloise H. Gill, Edmond Giraud, Leonore Rothschild Glasner, Gussie A. Gloshen, Rae S. Goldberg, Benjamin Goldwasser, Elizabeth Winter Gommi, Cornelia K. Goodrich, W. C. Gough, Goldie Beck Gould, Boyd Graham, Frances P. Graham, E. St. J. Greble, Arne A. Gregor, Flora B. Grimm, Etta Gross, Frances L. Grover, Donald H. Guibord, Nannette Naeve Gundlach, Waldo L. Gundlach, Helen F. Guth, Charles Lewis Guy.

James Hain, Edward W. Hall, Z. D. B. Hallett, Dorothy S. Halpern, James Hamer, Margaret M. Hammerschlag, H. W. Hardinge, Frank P. Harman, Perry Williams Harvey, W. K. Hatch, William H. Hay, W. E. Hayward, A. M. Helyar, Marjorie Henninger, Selma B. Herman, Clifford K. Hetherington, Baylor Ormsby Hickman, Harriette W. Hight, H. H. Hill, Jason Hinman, Lydia Hirschfeld, F. L. Hisaw, A. H. Hitchcock, Charles R. Hodges, John S. Holbrook, Susan P. Hols, Howard P. Homans, H. B. Hostetter, Henriette L. Howarth, Harold G. Hull, Wm. F. Hussenbuttel, W. D. Hyatt, Lidie L. Hynson.

Ethel F. Imlah, R. J. R. Irving, Walter Irving.

A. D. Jack, Thomas W. Jackson, Jr., John Jellen, Elizabeth S. Jennings, J. W. Jennison, Elizabeth Johnson, Alva Johnston, Joseph E. Johnson, Jr., Josephine C. Johnson, R. P. Johnston, Thomas T. Johnston, G. H. Judd.

Alexander Kadison, Suzanne Welsh Kahn, Howard Kane, Jennie L. Kass, William M. Kearons, Catherine Keating, John Frisbee Keator, L. E. Kelton, Jr., Alice C. Kernathan, Hermine Kind, Robt. S. Kinsey, John Caspar Kittle, Julia Sterling Knauss, Irving F. Krause, W. Krausnick, Florence E. Kurz.

C. A. Lafferty, John S. Lanier, P. I. Leach, Ellis W. Leavenworth, Katherine E. Lee, L. P. Lenone, Johanna Lewin, Jeannette M. Lloyd, George J. Loewy, Margaret M. Logan, Harry F. Louchheim, Catherine C. Lowe, Max Lowenthal, Wm. T. Lynch.

Hamilton W. Mabie, Marguerite G. MacAlman, J. Ralph Magee, Louise K. Maitland, John W. Manning, Michael Markels, Madeleine Wallace Martin, W. C. Martin, William P. Mason, Seabury C. Mastick, Clara A. Mastin, M. G. Mastin, Dean Mathey, W. J. Maxwell, S. W. McCallie, Guy A. McCorkle, A. R. McDicken, Jr., Florence McGaughey, John L. McKinney, Karl H. Messinger, Erich O. Meyer, Max Meyer, Ada E. Miller, Lloyd S. Miller, M. D. Miller, Seaman Miller, Carl E. Milliken, W. T. Millington, E. D. Mitchell, Minnie Wade Mitchell, Robert Mitchell, John Clark Moore, Sherman Moore, Anson D. Morse, Harry S. Moses, D. A. Moulton, Anne R. Mulvey, Helen C. Murphy.

Joseph Natwick, Elbert H. Neese, Albert B. Neill, Allen H. Nelson, Randolph Neyson, John D. Nichols, Edward J. Noble, Edwin C. Northrop, Mary B. Nutting.

Louise M. O'Donnell, F. W. Olcott, Harriet B. O'Leary, Sidney Olliver, R. Burt Orndorff, Margaret O'Ryan, C. E. Osterberg, Charles L. Overstreet, Elsie Burr Overstreet.

A. S. Page, Hubert T. Parson, Edward J. Pearscn, Vesta Greer Peeke, Caroline B. Pendleton, F. F. Perry, R. H. Perry, Curtis A. Peters, J. E. Peterson, F. W. Petri, Catherine B. Pickett, Walter B. Pillsbury, H. Ada Pintler-Thorburn, Mary C. Plant, H. C. Plum, T. E. Pollock, Irmis Barret Popoff, Eunice A. Porter, Ray Potter, Oliver Prescott, Jr., Dorothy Proffitt, Anna J. Prucha, Wm. A. Putnam.

Richard Austin Randall, L. V. F. Randolph, Gaston C. Raoul, William Read, M. J. Reutschler, Chester Reynolds, Alvan B. Ricker, Henry M. Rideout, A. A. Risley, J. Campbell Robinson, Theron Rockwell, Florence Roelofsma, F. P. Root, Arthur Rose, Robert Rosenbluth, Hans Rosenstock-Hussy, T. T. Rowe, William R. Rowe, Andre E. Rueff, Henry H. Rust.

Howard J. Sachs, Dorothy Sainsbury, John Sala, Anna N. Salomon, Wilbour Scofield, William Bacon Scofield, Fred Seager, May E. Seel, Maurice W. Seitz, Lee Shaeffer, John W. Shaw, Ora L. Shepherd, Lily A. Siegler, Beatrice Silverstein, Ernest A. Sinton, Berthe E. Slate, R. J. Slingluff, Laurita T. Sloan, Cora G. Smith, Edith R. Smith, J. H. Smith, Morton Smith, Robert I. Smyth, R. K. Snively, George B. Snow, Herman J. Sonnenberg, Louise Southgate, Harlo J. Sparks, C. F. Speary, John Campbell Spence, Louise T. R. Spero, Rebecca Spilo, Lillian R. Stabert, John W. Stanton, Theodore Clement Steele, A. T. Stensatter, S. H. Stephens, William L. Stephens, Harry S. Stoddard, Martha W. Storke, Mary E. Storm, Fred Strickland, Edna Stuebner, Alice D. Sueter, Marguerite K. Supple, Pauline Sterling Surrey, Richard E. Sykes, Gustaf Sylvan.

F. N. Taliaferro, Ada H. Taylor, Ruth M. Taylor, Charles N. Teetor, Charles W. Terry, B. H. Terwilliger, Wm. H. Thatcher, Edward D. Thayer, Lucy O. Thode, D. E. Thompson, Edwin Thompson, Elizabeth Thompson, James P. Thompson, Ruth Abbe Thompson, Dorothy E. Thornton, Mabel H. Tilton, Randolph Tobias, C. H. Tomkinson, R. L. Trask, Josephine M. Tredwell, W. Troy, John B. Tufts, Ruth E. Tucker, H. G. Tuthill.

Horace A. S. Upham.

Laura E. Vail, George S. van der Werken, Leightan C. Van Trump, F. K. Vandervoort, Bessie C. Veino, Robert G. Vickery.

J. M. Wainwright, John J. Walker, W. W. Wallwork, Robert W. Walsh, Nancy Hill Wanner, Annie M. Ward, Samuel N. Warden, O. A. Warren, Clinton H. Watson, Laurence J. Webster, Percy E. Wells, Sigurd R. Wendin, Henry O. Wheeler, Anna R. White, C. H. White, James R. Whiting, Julia L. Whitney, M. V. Wiese, Frances W. Wile, J. T. Willard, Paul Sawyer Willard, Joseph Willen, Augusta Willhardt, C. L. Williams, George A. Williams, Sydney M. Williams, W. R. Wilson, Belle F. Winestine, Una R. Winter, R. P. Wirth, F. Eleanor Wolff, Willingham Wood, Alfred E. Wright, Charles A. Wright, Henry R. Wubbenhorst.

J. L. Yeager, Henry Young, Ada Young-Homer.

George A. Zabriskie, 2d., Frank Zeloski, Walter A. Zinn.

Sister Clare.

Misses Ardis Francis Adams, Elizabeth Hildreth Adams, Kathrene Adams, Mabel H. Adams, Ruth Katherine Adlum, Maud Akerly, Mabel M. Alcorn, Virginia Alford, Rose A. Allan, Lillian Backus Allen, Ruth Allen, Mary Pardee Allison, Carrie Althause, Rose Lillian Amols, Marjorie V. Andersen, Gladys Olds Anderson, Helen M. Anderson, Mary Anderson, Mary H. Anderson, Sophronica Anderson, Lena E. Annis, H. Barbara Aranguren, Pearl Armstrong, Charlotte Ashdown, Blanche Augustin, Sarah Averill, Lucile Avery.

Doris Anne Bach, Florence M. Baker, Helen A. Baldwin, Ida Balles, Marian Bardwell, Ethel P. Barker, Margaret V. Barry, Helen F. Bartels, Marguerite Bartels, Marjorie Jean Bassett, Caroline N. Baxter, Esther Bearss, Rachel E. Beatty, Gertrude Becker, Hazel V. Behan, Marie Behrens, Grace S. Bell, Mary S. Bennet, Mildred V. Bentz, Bella Berkowitz, Florence R. Berney, Ella Louise Bidwell, Mary E. Bielenberg, Clara L. Bigelow, Frances Billings, Geneva Bird, Mary V. Bird, Mary C. Bissell, Alice E. Bivins, Ann

Louise Blank, Theodora C. Blodget, Ilse Bloede, Dorothy M. Blondel, Martha F. Blood, Jessie White Boerstler, Elsie M. Bond, Clara C. Bonn, Adelaide Bonnell, M. Irene Booth, J. Dorothy Borgstede, Gunhilde C. Bothner, Lola E. Botts, Martha E. Bowen Rowena Bower, Louise M. Boyden, Pauline B. Boyden, Ella Bradley, Mary M. Bradley, Mayflower Breeze, Margery L. Brett, Natalie Brewster, Eva E. Briggs, Florence Mayfred Briggs, Muriel A. Brittin, Elizabeth F. Broden, Lina Brodsky, Clara Brogan, Clara Jane Brown, Katharine L. Brown, Ruth W. Brown, Katharine Brush, Theda Buck, Margaret C. Buckingham, Dorothy Buckley, Kate Bullock, Bertha Bunert, Elsa Burgi, Rose M. Burke, Esther V. Burritt, Louise E. Burrows, Jeannette R. Busch, Elsie M. Bush, Ellen M. Bywater.

Grace E. Cady, Hazel G. Caldwell, Martha Paulyne Caldwell, Mary E. Caldwell, Marie A. Callahan, Mary A. Callahan, Anna May Callan, Alberta E. Calvin, Barbara Campazzie, A. C. Marion Campbell, Charlotte M. Campbell, Olivia Campbell, Isabel E. Canale, Lois J. Capell, Linda Cappannari, Emma A. Carey, Madge Carey, Rhobie L. Cargill, Grace Merle Carhart, Catherine D. Carlson, C. Grace Carnahan, Laura May Carroll, Florence V. Carson, Grace Carstang, M. Helene Casey, Lillian F. Cass, Sally Cassidy, Elsa M. Chafee, Laura A. Chamberlin, Phyllis R. Chambers, Harriet A. Champion, Irene Chase, Mattie Lee Chatham, Lena M. Cherichetti, Harriet E. Cheshire, Mira Childs, Marie Christine, Elsie Christopher, Anna Chuckrow, Laura Cioffi, Elizabeth Clabes, Edna Elithe Clark, Jeanette B. Clark, Nelle M. Clark, Mary P. Clay, Georgina M. Clayberg, Anna R. Clayton, Margaret Cleary, Florence Clements, Catherine Susan Clodfelter, Mary Seaman Clowes, Jane H. Coakley, Berta Cobb, Christine A. Cochran, Maybelle Cochran, Rosalind O. Coe, Marietta S. Coffin, Mollie Grayce Cohl, Carrie K. Colby, Adele Coleman, Katharine Brownell Collier, Claudia Colonna, M. Korleen Comins, Catherine M. Connolly, Zita Helene Connolly, Mary E. Converse, Blanche G. Conway, Ada Mae Cook, Andrea A. Cook, Marguerite Cook, A. B. Cooke, Blanche E. Cooke, Martha Cooney, Frances E. Corry, Grace L. Cortright, Catherine Costigan, Stella Dickinson Coughran, Margaret Anne Cowan, Mary E. Cowan, Edna Craig, Vera M. Crane, Frances J. Cronan, Mae Cronan, Mildred Cross, Rose R. Crysler, Anna M. Culbert, Joan Cummings, Mary A. Cummings, Mary L. Cummins, Ethel E. Cunningham, H. Ida Curry.

Ethel M. Dammrich, Henrietta D'Aran, Cora E. Davis, Lucia Marie Dean, G. Elinore DeCou, Desiree Delcroix, Anna DeRonde, Edith Deutsch, Elizabeth de Urzaiz, Addie E. Deveson, Ethel Grace DeVoe, Bertha O. Dick, Gladys Dickerson, Jean B. Dickson, Eleanor C. Diehl, Annette I. Dietz, Eleanor Dihlman, Frances Ditolla, Francesca R. Dobson, Helen Whittemore Dodd, Marie D. Doelger, Mae Doherty, Ethel G. Donaghy, Lillian Donald, Marie E. Donovan, Frances M. Dorman, Helen F. Dowling, Marie I. Dowling, Josephine A. Downs, Margaret B. Downs, Helen MacKnight Doyle, Louise M. Drew, Eloise P. Driggs, Anna M. Driscoll, Jean Driscoll, Marcia O. Dunham, Marian Durell, Helen M. Durfee, Jeanette Dutchess, Clara B. Dwight, Berenice Dykeman.

Florence R. Eddy, Lois Edmundson, Mabel Egbert, Lillian M. Elliott, Margaret G. Elliott, Nellie T. Elliot, Helen Ellis, Anna Elsbree, Grace G. Engleman, Genevieve K. Enright, Phyllis Epstein, Ruth E. Erb, Marjorie Estes, Alice R. Everett.

Elsie Farrell, Helen T. Farrell, Dorothy M. Farst, Bertha W. Ferguson, Lillian M. Fernald, Pearl Irene Ferrin, Harriet Field, Dora Finney, Gertrude Jay Fischer, Margaret Ingersoll Fiske, Mary E. Fitzgerald, Mary E. Flannery, Ruth Walker Forbes, Gertrude Forrester, Estella Fox, Mary Fox, Alice L. Fraser, Claude M. Frederick, Lillian M. Friedman, Ellen Trabue Friend, Eleanor H. Frick, Amelia H. Fritz, Helen Frownfelter, Elsie C. Fullington.

Ida Galmitz, Dorothy Gansberger, Alice S. Gardener, Julia Gardner, Helen Garrett, Frances H. Gearhart, Ruth M. Geerlings, Anna Gemerd, Lucy L. Gerlach, Dorothy J. Gibbons, Helen S. Gibbs, Dorothy Jane Gibson, Edna M. Gibson, Elizabeth B. Gifford, Genieve N. Gildersleeve, Helen F. Giles, Clara Evelyn Gill, Mary A. Gillen, Helen M. Gillette, Laura B. Gilmore, Esther H. Gilpin, Lillian Girard, Elizabeth C. Glutsch, Jessie A. Godfrey, Marie Dolores Goggin, Marjorie Eunice Gooch, Willystine Goodsell, Jonnie Gore, Helen A. Gorman, Fleurene S. Gosben, Lena M. Gould, Ruth Graae, Katherine C. Graff, Jessie L. Graham, Marie W. Grahl, Gertrude May Grant, Josephine Grant, Mary Grant, May R. Grant, Ethel C. Gray, Magna A. Gray, Margaret Gray, Minnie G. Gray, Ruth Gray, Ethel Greenburg, Lucy Griffith, Mildred M. Grimm, Alma E. Grinton, Esther D. Griswold, Helen Grochowski, Lillie Groesser, Ella Gross, Blanche O. Guardenier, Ella Farnham Gude, Mabel A. Guild, Marie S. Gumbs, Cora Gund, Henrietta H. Gunsten.

Ruth G. Hadley, Eva Hagan, Evalina R. Haines, Grace D. Hall, Lois E. Hall, Marion S. Hambleton, Mildred Hamburg, M. Lilian Hand, Florence M. Hannan, Inez J. Hanscom, Henrietta Hanson, Dorothy Hardcastle, Gertrude A. Hardy, Marguerite E. Harkness, Sara J. Harlem, A. C. Harmon, Myrtle Harmonson, Bertha Harms, Bertha M. Harris, Edna E. Harris, Elizabeth S. Harris, Jean A. Harris, Beatrice M. Harrison, Agnes Elizabeth Hartman, Irene E. Harvey, Louise Hasleen, V. Pauline Hayden, Harriet Hayes, Cecilia E. Healy, Gertrude M. Healey, Henrietta Hearsey, Dorothy T. Hebner, Louise F. Heldman, Lena Hendel, Bertha Henkel, Edna M. Herndon, Stella Herron, Marian Heseltine, Emma C. Hess, Edna S. Hicks, J. Edna Hickson, Mabel Chelton Hinton, Clara Hinze, Magdelen M. Hitzler, Dorothy M. Hobson, Helene M. Hogan, Mary E. Holland, Anna Hollwegs, Gertrude M. Holt, Ruth Hornby, Caroline G. Howe, Alice Howenstine, A. S. Hoyt, Elizabeth M. Huber, Lilly M. Hubschmitt, Mabel Ruth Hudson, Anna V. Huff, Janet Hull, Marie Hume, Bertha C. Humpal, M. K. Humphrey, Amy S. Humphreys, Florise H. Hunsucker, Florence Stewart Hunt, Margaret Hunt, Selma Hunt, Anna Hurtt, Helen Audrey Hutton, Marguerite Hyer.

Vera Ingersoll, Leah Isaacs, Margaret Ives.

Ruth D. Jackson, Eleanor D. Jahelka, Alice Jeffer, Catharine C. Jefferies, Laura L. Jennings, Marjorie F. Jephson, Clarice M. Jerome, Astrid Johnson, Elizabeth B. Johnson, Mabel C. Johnson, Claudia Johnston, R. Isabel Johnston, Susan Dyckman Johnston, 2d., Gladys Pitt Jones, Mildred M. Jones.

Charlotte E. Kahler, B. Elizabeth Kallman, Marie A. S. Kamna, Sybil Kent Kane, S. Kanenbley, Estelle H. Kaplan, Wilhelmine Ruth Kappes, Gertrude Karr, Gisella Kauf, Ann Kayser, Carrie Wallace Kearns, Adelaide M. Keleher, Agnes D. Kelleher, Elizabeth Kelley, Helen Kelley, Hilda A. Kelley, Margaret Kelly, Muriel S. Kendrick, Gertrude B. Kennaday, Emma L. Kennedy, Kathryn M. Kennedy, Mary Kent, Florence Kerigan, Doris A. Kersell, M. Irene Kerstetter, Irene Kilgalon, Virginia M. Kimbro, Alice T. Kincaid, Adelaide Ruth King, Sarah E. Kirk, Bertha A. Kirley, Margaret E. Kitchelt, Blanche A. Kittle, Anna M. Klein, Onata A. Klossner, Ruth Marie Klotz, Charlotte D. Knox, Elsie G. Knox, Leila Charlton Knox, Thelma L. Kranich, Marie Kravietz, Josephine F. Kreutzer, Olga A. Kruesi, Ruth B. Kurmes, Ethel G. Kyte.

Pearl Lafferty, Elizabeth Laine, Barbara Stryker Lake, Edna F. Lake, Hazel E. Landeen, Patricia Lane, Julia E. Lanigan, Alice H. Lapidge, Isabel Larsen, Freda R. Lavine, Grace L. Lawton, Carrie Leaman, Bess Ledford, Mary Hamilton Leech, Katherine Leffler, Sadie Lefkowitz, Alma Magdeline Leining, Ella S. Leonard, Alice Josephine Libby, Frieda Lichtman, Antoinette Light, Margaret A. Lindquist, Margaret G. Lindquist, Miriam C. Lindquist, Therese Lindsey, Irene P. Link, Lynette Loeber, Ada L. Lohman, Christiana Lohrmann, Marie I. Long, Virginia E. Long, Jean Loomis, Elsie R. Loope, Frances Gates Lord, Lois Lott, Susan H. Lovald, Anna Loveland, Ethel L. Lowenthal, Ella I. Luckings, Laura Lunde, Marguerite Mary Lynch, Mary J. Lynch, Helen Merrell Lynd, Alice E. Lutters, Suzie L. Lyons.

Marie Florence MacConnell, Bessie MacCollum, June MacFadyen, Alice H. MacGrotty, Eleanor C. Mackay, Maud M. MacKenzie, Vivien C. Mackenzie, Florence E. Macnamara, Edith Magalotti, Charlotte M. Magee, Theresa Celestine Mages, Loretta Maher, Florence Voss Mahnken, Elizabeth Mahoney, Eleanor Mallalien, Hermine I. Mamlok, Genevieve Bland Manzi, Ida Markowitz, Eleanora M. Martin, Mildred P. Martin, Hannah E. Marvin, Louise M. Marx, Jane Hulett Massion, Jane Matthias, Mary M. Maxwell, Ethel M. McCarley, Mary E. McCarthy, Olive F. McConkey, Jennie A. McConnell, Mary McCune, Elizabeth A. McFadden, Irene E. McFaul, Myrtle B. McGraw, Mary M. McGuire, Margaret L. McIlduff, Lucy Atkinson McIlwain, Mary D. McKenna, Teresa McKenna, Mary C. McKeon, Julia H. McKibben, Mary Ida McLawhorn, Margaret B. McLean, Dorothea R. McNutt, Marie L. C. McNally, Marguerite E. McQuaide, Frances E. Medlock, Minnie Melton, Margaret Mercer, Alice Metcalf, Aline Marguerite Meyer, Eleanor D. Meyer, Jeannette M. Meyer, Julia A. Meyers, Ella V. Miller, Mildred A. Miller Helen Keeling Mills, Katherine C. Mills, Lena Irene Mills, Camilla F. Miner, Margaret A. Mitchell, Bertha A. Moat, Margaret E. Molitor, Gabrielle Moncure, Margaret E. Moon, Gay Morgan, Gwendolyn Whitney Morgan, I. Florence Morley, Anne Dye Morris, Margaret B. Morrison, Sarah F. Moss, Flora L. Motts, Gertrude H. Muench, Lillian M. Murray, Louise Musgrove, Katherine M. Myers, Marjorie L. Myers.

Bertha I. Nelson, Ethel Madeline Nelson, Theresa Newman, Louise Newton, Meredith Nichols, Ella G. Nimptsch, Elizabeth A. Noble, Nell Nollen, Anna L. Nordsiek, Lois North, Florence M. Northrup, Ella M. Norton, Helen Noyes, Marion A. Nuneviller.

Marie E. Oatman, Gladys Oberlin, Katharine I. O'Connell, Catherine G. O'Donnell, Beatrice Oldeack, Mildred A. Oliver, Anna Seiz O'Neill, Frances L. O'Neill, Louise E. Opitz, Esther C. Orlinger, Minnie Ornstein, Hattie Orr, A. Gertrude Osborne, Agnes R. O'Toole, Addie C. Owen.

Jane Packard, Marjorie Beatrice Packard, Thelma Packham, Mary Paget, Doris E. Parke, M. F. Parkinson, Pia L. Pastorini, Janet G. Paterson, Jessie D. Patton, Mary B. Peabody, Mildred J. Peaslee, Alma Pedersen, Edith F. Pelly, Ursula L. Penner, Mabel Groat Pepper, Verabel Perry, Marjorie Persons, Anna R. Pettebone, Edna Pettit, Gertrude G. Phair, Josephine M. Phelps, Ellen Morgan Phillips, Isabel M. Phoenix, Fay N. Pierce, Agnes Pierpont, Joan V. Pike, Eleanora D. Plumb, Marion V. Polian, Erminie L. Pollard, Bertha J. Popp, Lillian M. Potter. Mary E. Powers, Elizabeth A. Preston, Alice M. Price, Ethel E. Probst, Clara S. Pulsifer, Theresa Puseman.

Lillian L. Quimby.

Dora A. Radlo, Buena Vista Raines, Ruth Randel, Eva Rappleye, May I. Raven, Helen Raymond, Mary Recher, Helen C. Redmond, Elizabeth F. Reed, Mary A. Regan, Ruth Arnett Reichel, Ursula Reichle, Catharine H. Reid, Gertrude Reier, Dolly V. Reilly, Marie Reimer, Ruth Reiner, Blanche Reynolds, Grace A. Rice, Mildred Rich, Rose Richardson, Ethel Louise Rider, E. Adele Riehl, Ethel F. Rigg, Adelaide V. Ringen, Lena I. Ritchie, Margaret Ritsher, Adele Rittenhouse, Ada F. Roach, Deborah Robinson, Elinor T. Robinson, Gertrude D. Robinson, Julia Robinson, Mary L. Robinson, Clara C. Rogers, Sue Jackson Rogers, Gladys Rohrs, Clara Rosa, Etta H. Rosenbaum, Helen Carpenter Ross, Metta J. Ross, Elizabeth Rothermel, Bess M. Rowe, Zola Belle Ruggles, Dorothy Rulifson, Emmy Matt Rush, Mollie R. Rush, H. Merle Rushby, Lillian E. Russell, Mary M. Ryan, Frances Rynar, Esther H. Ryttenberg.

Almira F. Safford, Kate Branson Scannell, Grace A. Schaefer, Florence W. Schaper, Elsa Scheerer, Betty Schilling, Dorothy G.

Schmidt, Katharine Scholl, Leslie Schoonmaker, M. Leota Schroeder, Marcella Schroth, Marie F. Schuette, Edith C. Schultz, Margaret A. Schultz, Olga Schwab, Virginia M. Schwarte, Lillie Schwartz, Edna L. Schwenk, Helen M. Scott, Marion Grace Scott, Sara Alicia Scudder, Irene E. Seale, Marie P. Sealy, Helen M. Seamans, Theola M. Sebastian, Florence M. Seelert, Mollie Seletsky, Mabel Service, Dorothy D. Sewall, Lula K. Shannon, Susan E. Sharp, Letitia Flanagan Shaw, Ruth A. Shaw, Ethel May Sheldon, E. J. Sherman, Mary Jo Shockney, Ethel M. Shrewsbury, Marion E. Sible, Rea Silverman, I. Jewell Simpson, Dorothy A. Sisson, Melva N. Sitlinger, B. R. Skinker, Cora Amelia Smith, Elizabeth L. Smith, Laura M. Smith, Mary Campbell Smith, Ruth E. Snyder, Helen Sohns, Fae Sotherland, Helena E. Spisak, Mary E. Stafford, Gladys D. Stalter, Anne W. Steele, Helen Steiner, Grace R. Stevenson, Anna M. Stewart, Isabella D. Stewart, May A. Stimpson, Catharine A. Stirewalt, Nova B. Stirwalt, Anna M. S. Stokes, Marion Rush Stoll, Dorris M. Stone, Katharine K. Story, Leora Stranahan, Merna Straub, Catherine B. Streeter, Marguerite Streit, Augusta Glessner Stuart, Mary A. Stubbs, Frances Sundin, Mae Surgan, Grace A. Swallow, Vivian C. Swanson, Veva Mae Sweigart.

Florence Tangney, Helen A. Tannar, Anna Minerva Tarr, Harriet M. Taylor, Lucinda Lee Terry, Betty M. Thacker, Florence Thomas, Grace M. Thomas, Doris Thompson, June Thompson, Thea C. Thompson, Helen M. Thoms, Ruth M. Till, Alvina Timmerman, Margaret S. Tinne, Helen Ward Tippy, Frances, Zettler Tobler, Elizabeth M. Tompkins, Ruth Jane Totman, Julia Towbin, Margaret E. Townsend, Helen F. Tredick, Minnie A. Tribby, Annie E. Triebner, Florence Trochill, Katherine T. Turbett, Berenice R. Tuttle.

Susan W. Underwood, Alice Urbon, Mary Urmston.

Katharine Van Horne, Sarah S. Van Mater, Cecilia C. Varchetta, Mary A. Veeder, Marie Ver Bryck.

Caroline Wakefield, Isabella Wakeham, Frances E. Waldron, Grace R. Walker, Laura M. Walsh, Marie Alice Walsh, C. M. Walter, Frances S. Walters, Elvira L. Ward, Mary Ann Ward, Elizabeth Kate C. Warder, Ethel B. Waring, Florence Lucy Warner, Marie Annette Waters, Alice E. Watson, Esther Josephine Watson, Violette L'H. Watt, Jessie M. Webster, Isabel M. Weeks, Pearl M. Weeks, B. Weidman, Rosalind Weiss, Edith D. Weitzman, Helene O. Weller, Theodora Werner, Frances L. West, Lula West, Grace D. Weston, Hattie B. Wetherbee, Elsie L. Wetzel, Nellie L. Whiting, Elizabeth L. Whittaker, Philip Whittaker, Effie M. Wicklund, Ida Ireland Wicks, Helen Lucille Wilbur, Gladys Wilcox, Dorothy Williams, Elizabeth V. D. Williams, Eleanor V. Williamson, Ruth Williston, Anna T. Wilson, Gertrude R. Wilson, G. Ruth Winter, Harriet S. Winter, Julia A. Winter, Theodora Winthrop, Elsie Witchen, Mary Wolf, Minna F. Wolf, Emily Victoria Wood, Eva C. Wood, Helen E. Woodley, Bertha S. Wooster, Ann Mason Worcester, Frances A. Wright, Anne M. Young, Dolores Marie Youngblodt, Marie L. Yunge, Adelaide Zanelli, Helen F. Zimmerman, Rebecca H. Zirkin, Barbara M. Zuebert.

Right Reverend Joseph A. Delaney.

Reverend Doctors R. S. Eastman, Milton G. Evans, Wallace H. Finch, Paul Fox, Ezekiel Leavitt, W. A. Petzoldt, Louis Vanden Burg.

Reverends V. L. Biczysko, John Ner Borton, H. R. Burkett, Henry Anthony Clark, Joseph Cocoran, H. G. F. Courtney, G. Gerrer, Purdy Halstead, Jr., C. J. Harpold, Joseph C. Herrick, Wm. Lyndon Hess, D. Wilson Hollinger, Cyril J. Hoover, Leonard J. Kramer, James Enzer MacDonald, F. H. Morgan, F. J. Plutz, E. B. Rohrer, John Bernard Root, Roland L. Rupp, R. L. Shipley, O. Warren Smith, J. S. Ladd Thomas, Jay A. Wabeke, George Weir, Philip Wiggermann.

Rabbis Victor Eppstein, Sol. Landman.

General Fox Conner.

Brig. Generals Louis McCarty Little, U. S. M. C., Henry S. Sternberger.

Colonels C. E. Frazer Clark, Alonzo Gray, Osmun Latrobe, Edward McLeer, Jr., Estes Nichols, Thomas A. Rothwell, W. McI. Wolfe.

Lieut. Colonel F. Gardener.

Lieut. Commander W. C. ToozeGerard H. Wood.

Majors Alvord A. Cederwald, John D. Hood, Rex K. Latham.

Captains Stewart E. Barber, U.S.N., Hubert B. Bramlet, Geo. C. Farnsworth, Paul S. Frank, U.S.A., F. A. Levis, Paul S. Rutledge.

Ensign G. O. Olson.

Sergeant Virgil G. Duncan, U.S.A.

Doctors Armand J. Abrams, Carl R. Ackerman, S. A. Alessi, Abbott William Allen, Everest J. Allen, Benjamin H. Alton, Vincent J. Amato, James E. Ament, Daniel A. Andrews, Gualberto Arcos, Edward McPherson Armstrong, Ernest E. Arnheim, Francis J. Arnold.

H. E. Bagley, Charles E. Baker, Charles J. Baker, Valentine Collamer Baker, Maxfield Barber, Leland Barrett, Arthur M. Barrows, Paul J. Bauerberg, Louis Bauman, Elmer H. Bausch, John J. Beard, Paul W. Beaven, Charles E. Beck, Irwin Beckhard, Chas. L. Bennett, Philip H. Berlenbach, Joseph F. Bicak, Emilio Biosca, Albert Blau, Charles D. Bles, Marcus T. Block, Walter L. Blomgren, W. R. Blume, J. L. Blumenthal, H. L. Bockus, Milton Bodenheimer, William T. Boland, Eleazar R. Bowie, F. J. Brabec, W. V. Branford, Addison G. Brenizer, Leonard W. Brewer, Conrad Briner, Isra Tobias Broadwin, R. Innis Bromley, Lucien M. Brown, Thomas E. Brown, Elmer C. Bruch, Howard G. Bruenn, Weston Bruner, Louis M. Bull, A. H. Bungardt, A. L. Butler.

W. LeRoy Cahall, George W. Cale, Jr., George G. Carroll, Robert S. Carroll, B. H. Caswell, George Scholl Cattanach, John N. Chain, Joseph S. Chasnoff, John A. Clark, John D. Clark, Seymour G. Clark, A. Vernon Clarke, Milton Henry Clifford, Raymond C. Coburn, Philip G. Cole, William Dean Collier, John Colvin, Thomas W. Connolly, Ethel B. Cosby, Judson G. Cottrell, R. L. Crockett, Joseph W. Crowley, John J. Curley.

Ernest M. Daland, William H. Daniels, Thomas M. d'Angelo, T. E. Daugherty, Vartan A. Davidian, Alexander G. Davidson, Paul B. Davis, Alex. Heron Davisson, R. T. de Hellebranth, Clarence E. de La Chapelle, C. L. De Meritt, Clyde Leroy Deming, Joseph De Pietro, Dean C. Denman, Rodolphe L. Desaulniers, S. H. Dik, Leon Diska, Ira M. Dixson, F. J. Dobrovolny, C. York Douglass, T. McKean Downs, P. Drummond, Glenn D. Dunmire, Fannie W. Dunn, Earl T. Dutton, James H. Dwinelle.

Isaac E. Edelman, Fidella Edwards, Harold L. Ellis, Richard T. Ellison, Herman L. Enselberg, Adolph Frederick Erdmann, Joseph P. Essner, Jay I. Evans, Lysle R. Everhart.

J. R. Fabricius, Albert Faller, E. C. Farmer, Frederic James Farnell, Edward P. Feder, Nathan Feldman, Charles Ferguson, George Adolph Fiedler, Herman A. Fischer, Jr., John B. Flick, Hilda C. Fliegel, H. T. Floyd, Ralph P. Folsom, Louis H. Frechtling, Sidney H. Freilich, F. W. Frerichs, Harry Frey, Erich Fricke, Frank J. Frosch, H. L. Frosch, Lowell C. Frost, H. C. Fulda.

James A. Gafford, Jules Octave Gagnon, Morton Gittelman, John Geo. Glover, William J. Godfrey, William Howard Godsick, Milton J. Goodfriend, Edward H. Goodman, Samuel Goodman, Mark Gordon, Charles Graef, Saverio Greco, Clifford H. Griffin, John L. Groh, Samuel Frederick Groopman, Julius Grossman, F. Nelson Groves, Donald J. Grubb, Joseph A. Guertin.

Clark H. Hagenbuch, William M. Hale, Wallace B. Hamby, Gordon Battelle Hamilton, Seth A. Hammel, Andrew H. Hangarter, E. A. Hannum, D. L. Harris, Clifford D. Harvey, H. E. Haskins, Bernard Hatz, E. M. Hawks, George Hay, Geo. E. Hayunga, Charles E. Helm, F. Royal Hendricks, J. V. Hendricks, Frederick K. Herpel, Francis H. Herrick, Joseph Herzstein, Carl A. Hettesheimer, Siegfried Heyl, Charles A. Higgins, L. L. Hill, Frank W. Hodgdon, George W. H. Horre, Edward J. Howland, Reeve B. Howland, Lyman H. Hoyt, Harry Hudson, Ernest L. Hunt, William Hutchison.

Thomas Jameson, D. Rees Jensen, Juanita P. Johns, T. O. Johnson, Frank A. Johnston.

Leo A. Kallen, Emanuel B. Kaplan, Murray L. Kaplun, Paul H. Karcher, John N. Katrana, Moses Katz, Lesser Kauffman, John H. Keating, H. E. Kelsey, J. Harrison Kemp, Edwin John Kepler, Eugenia Ketterlinus, J. J. Klein, E. L. Klock, William S. Knox, Geo. W. Koch, Emil J. Krahulik, James G. Kramer, Franklin B. Krauss, Daniel Kravitz, Isadore Kuritzky, Charles F. Kutscher.

Harold W. Laauwe, Charles I. Lambert, Edward J. Lang, F. A. Laurer, George A. Leahey, Montgomery E. Leary, Theodore Le Boutillier, Charles A. LeCates, Theodore H. Lemmerz, Geo. M. Levitas, Abel Levitts, Philip John Lewert, Leon Lewis, David Paul Lieberman, Martin Liling, Mabelle G. Little, Paul A. Loefflad, Clarence E. Lommen, Paul H. Lowry, Oswald Swinney Lowsley, Walter D. Ludlum, L. E. Luehrs, C. W. Lurring, Harold Lusskin, Thomas H. Luther.

A. Garrard Macleod, T. Maginnis, Arne E. Mantyl, Irving E. Marks, Frank A. Marshall, Seth H. Martin, A. M. Master, Ralph E. Maxwell, Charles A. McDonald, Marsh McCall, Thomas H. McClintock, Samuel McCullagh, Junius H. McHenry, Evan W. McLave, H. W. McNitt, Charles H. B. Meade, Meyer M. Melicow, Louis Mendelsohn, A. S. Merrill, Edward Lester Merritt, Alfred Meurlin, Charles Joseph Meyer, J. Minkin, C. L. Moad, C. A. Mohr, Merl P. Moon, Frank Moormeister, Roy F. Morehouse, Audrey G. Morgan, Maximilian Morgen, William A. Morris, John H. Morse, Walter E. Moyer, H. B. Moyle, John K. Musgrave.

David I. Nalitt, Edmonde D. Neer, James D. Nelson, Gerald Neuschatz, Thomas F. Nevins, Wallace J. Nichols, Ralph G. Nicholson, S. J. Nilson, Wm. D. Noble, H. Allan Novack.

Joseph A. O'Connor, C. T. Okey, Marcus C. Old, Eugene A. Osius, Arthur K. Owen.

Charles E. Padelford, M. E. Page, Z. Rita Parker, Carlo Pascarelli, Nicholas G. Pattakos, Charles Tabb Pearce, Victor L. Peirce, Maurice M. Perlson, O. J. Pettinger, Mather Pfeiffenberger, Milton B. Philips, Eugene B. Pierce, Norval H. Pierce, Albert W. Pigott, L. J. Placek, Alfred Plaut, Louis J. Polimeni, Fred Pritham.

Geo. B. Randall, Joseph Raphael, William B. Rawls, Julian L. Rawls, Arthur H. Raynolds, Frank L. Rector, Charles B. Reed, S. R. Reelhorn, John Davis Reichard, Alvah C. Remington, Dan S. Renner, Louis Resman, N. J. Resmer, Winifred V. Richmond, S. S. Richstone, George W. Riley, Isador Ripps, Otto E. F. Risch, Arthur L. Roberts, Robert Crawford Robertson, William J. Robinson, Richard M. Rogers, Eugene F. Rooney, Pauline Root, Chas. K. Rose, Jr., J. L. Rosenberg, L. Chas. Rosenberg, J. D. Rosenman, Solomon P. Rosenthal, W. F. Rossman, Eugene Roth, Charles F. Rourke, William D. Rowland, Francis H. Rowley, Bernard Rudin, W. L. Russell, W. Marler Russell, Eric J. Ryan, Ernest N. Ryder.

Zachary Sagal, Louis J. A. Salmon, John A. Sampson, Charles H. Sanford, A. I. Saper, Paul Kurt Sauer, B. L. Schaeffer, D. Howard-Shaffer, L. Scheib, Angelo S. Scherma, George Ted Schimelpfenig, R. D. Schimmelpfennig, Karl Schlegel, Julius Schreiber, Louis J. Schreiber, Frederick A. Schroeder, Henry C. Schumacher, Max

Schwarz, Jerome M. Schweitzer, Louis Sheinman, Bernard Shermer, J. A. Shields, Joseph Shohan, M. Silberstein, J. Gorse Simmons, I. S. Simons, S. S. Simons, Abraham Smith, Matthew T. Smith, Thorsten Smith, Virginia T. Smith, Walter Fox Smith, D. M. Snell, Henry B. Sokal, Theophile C. Sousa, Frank Spano, Linden N. Spitzer, David Haskell Spotkov, Ann Staatz, John S. Staneslow, Eugene R. Stefanelli, Clarke W. Stewart, Leopold Stieglitz, Harold E. Stish, Charles Irvin Stitler, George G. Stone, Howardson N. Stoute, L. R. Strahan, J. G. Stranch, Maurice J. Strauss, Alexander A. S. Stuart, Edgar Sturge, John W. Sugden, C. J. Swan, William J. Swart.

A. L. Tauro, Lorton H. Teeter, Frank Teller, John A. Theobalds, Hilland Bernard Thomas, Hartwell G. Thompson, James E. Thompson, R. Bernard Thompson, John Tinkler, L. Theodore Togus, Henry Trautmann, W. Wesley Trichler.

William C. Uhlig, Alfred Ullman, J. W. Utter,

Eleanor V. N. VanAlstyne, Walter K. VanAlstyne, Alexander Vanderburgh, Eugene N. Van Dyke, George S. Van Riper, Albert Vander Veer, Frederick P. P. von Keller.

Elisabeth B. Ward, Henry D. Watson, Tobias M. Watson, C. Berenda Weinberg, Max H. Weinberg, A. V. Weinberger, H. L. Welker, Joseph G. Welling, S. R. Werner, Leonard Paul Wershub, Frederic B. Western, Abe Ralph Wexler, William L. Wheeler, R. M. Whitehead, Frank A. Wilcox, Abraham O. Wilensky, Geo. P. Winchell, Orin R. Witter, W. Stuart Woodruff.

Albert A. Zelfman, F. G. Zinsser, D. F. Zits, Leonard Zweibel.

Chancellor Ernest H. Lindley.

Professors J. Norton Cru, A. L. Lugn, George Owen, Robert E. Park, George G. Scott, Louis Waldbauer.

Honorables Joseph A. Corio, Walter B. Jones, David A. Reed, Lewis H. VanDusen.

Messrs. Robert Abel, George Abeling, Chester B. Achilles, Charles E. Adams, R. R. Adams, Raymond F. Adams, Forrest Addition, Morton L. Adler, F. C. Ahern, Isaac Aheroni, C. L. Ahlering, William Michael Aichelman, Howard L. Akin, E. J. Albin, Frank M. Aldrich, George E. Alexander, J. E. Alexander, Pierrepont Alford, John L. Alheim, Carl F. Allebaugh, Arthur Francis Allen, George Wright Allen, Ivan B. Allen, Jr., Kent D. Allen, Lloyd C. Allen, Lloyd L. Allen, Mark W. Allen, Ray F. Allen, Vernon C. Allison, Herbert E. Allshouse, Fred Alspaugh, Oakes I. Ames, Adolph Anderson, Albert O. Anderson, Ernest H. Anderson, Forrest M. Anderson, Gunnar Anderson, Hu C. Anderson, Ivar Anderson, Kenneth E. Anderson, Louis F. Anderson, Paul Sanford Anderson, Walter W. Anderson, William Anderson, Don Ethelbert Andrews, E. W. Andrews, Loring Beal Andrews, Russell W. Angel, Hans Angermuller, Clarence Anthes, Emil Appenzeller, Robert W. Archbald, Jr., Charles Du B. Arcularius, W. C. Arkell, Harry A. Armitage, Arthur A. Armstrong, Robert Haydn Armstrong, F. N. Arvin, J. H. Asbury, Sam Ashe, Cyril F. Atkins, K. C. Atwood, Jr., Louis M. Augustine, Charles Luther Austin, Warren R. Austin, Jr., Oscar A. Ayala, Waldemar Ayres.

A. M. Bachmeyer, Louis Bader, E. H. Baderschneider, Asa George Baker, E. L. Baker, James K. Baker, John A. Baker, W. S. H. Baker, DeWitt C. Baldwin, Harry Baldwin, Robert E. Ball, William H. Ball, George H. Ballantyne, Laurence H. Bankart, Joseph Barber, Jr., George B. Barker, George S. Barker, Charles E. Barkl, H. C. Barlow, John T. Barnes, Melvin Barnes, Charles E. Barr, Harry K. Barr, Fred P. Barrett, Nat H. Barrows, Mark Barth, Francis B. Barton, P. L. Barton, Robert C. Barton, Clarke Bassett, Russell Bassett, Jack Texas Bate, Willard Baugh, Roland E. Beard, Samuel Moffatt Beattie, Edwin Bebout, Gaylord N. Bebout, Jr., Alfred C. Beck, Alfred Dykeman Beck, M. W. Beck, Russell N. Beck, Edwin J. Becker, G. E. Beckman, Paul Bedford, Henry Beeuwkes, Lewis C. Beilman, H. A. Beiswenger, Harry W. Bell, John G. Bell, Rudolph Belohlavek, R. D. Beman, George Benham, Milton B. Benjamin, A. H. Bennell, Dewey Bennett, Edwin Eversley Bennett, 2d., Edwin L. Bennett, R. H. C. Bennett, Ralph E. Bennett, Arthur D. Benson, B. M. Benson, Byron D. Benson, David F. Bent, Gerhard B. Berg, Gunnar H. Berg, Reidar Berg, Matthew G. Berge, Edward P. Bergeron, Rudolf L. Bergman, R. C. Bergmann, Edwin J. Berlage, Carlos F. Bernasconi, Gus Bernier, Lawrence Bernstein, A. Y. Berry, R. J. Bestul, Willis, Betts, Holger Bidstrup, William H. Bielfeldt, Hans Biermann, Clifford W. Bigelow, George M. Biggar, John L. Biggerstaff, Frederic C. Billings, George M. Bird, B. A. Birmingham, Allison Bishopric, C. S. Bissell, Eugene Black, 3d., C. D. Blackman, John Decker Blagden, Frank H. Blair, Rollin H. Blakely, J. Blakeman, George A. Blaiklock, Harold Blanchard, Walter Stairs Blandy, Samuel Blechman, Elias Bloch, Wesley Block, Morris Blodnick, Jack Blumberg, Jr., Alexander Watt Blyth, Edward Bockli, Frederick Wm. Bode, James A. Boden, Francis J. Boder, Carl Boettiger, Paul N. Bogart, Christian Charles Bohn, F. C. Bolles, Jr., John Bologna, George Boncesco, James Harvey Bond, Elwood S. Bonsall, Samuel L. Boothroyd, Charles Barry Borden, Richard P. Borden, Harry H. Bottome, F. J. Bowcock, Montel H. Bowdish, B. L. Bowen, Van S. Bowen, Jay H. Bowker, Walter L. Boxell, W. Richard Boyce, Wm. G. Boyce, Earl Boyer, H. J. Brackmann, R. E. Braddy, Charles Bradley, T. G. Bradley, John S. Brainard, Roy L. Brainerd, Joseph Brakeley, Simon Brandstadter, Paul Brandwein, Joseph Branigan, Argus Hoyt Brannon, Carter M. Braxton, Walter L. Breard, W. T. Breeze, Edw. Brennan, 3d., Patrick J. Brennan, Carl Breuer, Chas. E. Brewer, Herbert S. Bridge, J. Howard Brine, Daniel W. Brinson, Jr., James M. Brinson, Maurice Brodie, Harry D. Brookhy, Ben Curtis Brosheer, Benj. H. Brown, Charles G. Brown, Claude R. Brown, Edward Fisher Brown, Fred Brown, Gilbert B. Brown, H. Clifford Brown, Herman J. Brown, Jos. L. Brown, K. W. Brown, Francis H. Brownell, Jr., Watkins A. Broyles, George G. Brumder, Ernest A. Brunel, Fred H. Bruning, Henry Bruning, Jr., Thomas B. Bruton, Thomas K. Bruton, Joseph Bryan, 3d., Bruce Bryant, James B. Bryant, Thad A. Bryant, Jr., Wencel Brzezinski, Dwight S. Buchtel, Joseph W. Buck, Alfred Buckley, 3d., George Buckley, S. B. Bugge, Robert A. Bull, C. R. Buller, Albert C. Bullock, Charles H. Bullock, Paul H. Burbage, Jr., Frederick Burbidge, O. R. Burden, E. C. Burdick, Theodore E. Burger, Frederic Burkhardt, William E. Burleson, Harry S. Burnham, I. L. Burns, Louis H. Burrell, Edwards S. Burtis, Geo. A. Burton, August Busck, Edward C. Butler, H. R. Butler, Harold S. Butler, W. T. Butler, Rolston S. Butterfield, Prince Wolverton Byrd.

Edwin A. Cady, Charles Harry Calantjis, Claude Callahan, J. S. Calvert, Armino A. Campagna, A. P. Campbell, Duncan Campbell, John C. Campbell, Kenneth Lee Campbell, William M. Campbell, Con Campion, John Lawrence Carey, Dudley Carleton, Philip H. Carlin, Edward J. Carlson, Silvano Carmellini, Ralph C. Carmen, Clifford D. Carpenter, Edmund H. Carpenter, Philip Ray Carter, Richard L. Casanova, Harry Casey, Harry K. Casler, O. W. Caspersen, George W. Cass, Hugh B. Cassidy, Rafael Castillo, Allison G. Catheron, Ignatius J. Celona, Karl Cerny, Davis Challinor, Albert H. Chamberlain, Arthur B. Chamberlin, Thos. H. Chambers, Desmond B. Chandler, Harry N. Chapman, Lansing Chapman, J. Edward Chappel, John H. Chase, John P. Chase, M. P. Chase, George H. Chatfield, H. B. Chermside, Harry W. Chinn, C. F. Chisholm, Henry L. Chisholm, Peter Chittenden, C. H. Christensen, M. Christensen, Morrison Christie, Charles August Christman, Alfred W. Church, Austin H. Church, Wm. A. Chryst, Peter Chvany, Jr., Louis J. Cizek, Allen Clark, Andrew Clark, Dean Clark, Frank R. Clark, H. F. Clark, Harold Clark, Wm. L. Clark, B. Earl Clarke, C. H. Clarke, Caspar W. Clarke, J. A. Clarke, Jr., Lawrence A. Clifford, G. Curtis Cloos, George S. Clyde, Robert S. Clyde, Paul Noyce Coates, F. S. Cobb, Emory E. Cochran, David E. Cohen, Maurice S. Cohen, Edward Pendleton Colby, Leslie P. Coldsnow, C. W. Coleman, Dale Coleman, D. S. Collins, Jr., Samuel B. Collins, Henry I. Colman, Roswell C. Colt, R. G. Cone, Frederick W. Conger, I. M. Conkey, Herschel B. Conklin, Albert D. Conley, Morton S. Conrad, Thomas Stansbury Constantine, Earl W. Cook, Fred E. Cook, L. Russell Cook, C. C. Cooke, Hedley V. Cooke, E. S. Coombs, Reuel Cooper, Louis Corish, A. O. Cooperrider, Frederick L. Coots, W. H. Copeland, Patrick J. Corcoran, G. R. Corlis, Lee E. Cormany, E. B. Cosgrove, Nathan Cosminsky, Emanuel Cotic, John Boies Cotton, E. J. Counts, Charles R. Coville, Joe T. S. Cowen, C. M. Cox, Roger Conant Crafts, Elbert D. Crane, Bartholow Vincent Crawford, James W. Crawford, Horace Donald Crawford, Harold C. Crittenden, George C. Creelman, Carl A. Creutz, Katharine S. Crispell, John S. Crocker, Morris W. Croll, Hardy Croom, W. W. J. Croze, John C. Cudoba, Stephen B. Cummings, Carl H. Cundiff, O. Walter Cuneo, Joseph Oliver Cunha, Clem Cunneen, J. A. Curran, Arthur A. Cutman, Edward J. Czerniuk, Henry Czerny.

John T. Daly, Jr., Edward Dana, J. LeRoy Dana, John H. Dana, John Winchester Dana, Earl Y. Danner, Charles H. D'Ardussey, Robert A. Davenport, Robert S. Davenport, E. P. Davidson, A. L. B. Davies, Edward D. Davis, Frederick C. Davis, Jess F. Davis, Philip M. Davis, Jr., Putnam Davis, Jr., Robert L. Davis, F. H. Davol, Wesley C. Day, Miles Menander Dawson, Roger R. Dawson, Haskell R. Deal, Phillip C. Dearborn, Roland B. Dearborn, Pierre de Coulon, Charles A. Deile, Owen DeLang, Siegfried DeLange, Raymond C. Demarest, Carl E. Dent, William Truman DeSelms, Joseph Desloge, E. E. Desh, Louis L. Destremps, G. Dewey Detwiler, Marcellus DeVaughn, C. A. DeWare, Floyd Dewey, Frederic Dewhurst, Edward Ogden Dewing, James Bute Dick, Jr., James H. Dick, Richard W. Dickerson, Robert M. Dickey, George E. Dickson, Walter J. Dill, Edward C. Dimmick, Charles A. Dittberner, Andrew Robert Dixon, J. LeRoy Dixon, S. C. Dixon, Ethridge F. Doane, J. Alden Dobyns, Verne A. Dodd, H. F. Dold, Leslie C. Dole, Geo. W. Donahue, John W. Donaldson, John M. F. Donovan, Jr., Robert R. Dooley, H. Lloyd Dorn, Charles P. R. Dorschel, Egbert W. Doughty, Wm. Tyler Douglass, Jr., Thomas I. Dowling, Augustus S. Downing, Joseph E. Doyle, Solomon Drutz, Samuel Dubin, Charles L. DuBois, Harry C. Dudley, Robert R. Dunn, William S. Duncan, William H. Dunn, Jack W. Dunlap, Frank W. Dunning, John Duplak, Albert Jay DuPont, F. D. Durham, M. Ava Durham, Joseph A. Duross, John Homer Dye, Roland E. Dye, Frank M. Dyer, George P. Dyer.

Albert Eames, Jr., Norman S. Easton, George H. Ebert, Richard Wharton Echard, Sigmund Eckstein, James E. Edds, Leon Edelson, Sam Edelstein, Lanier Edmiston, Ernest A. Edwards, Francis C. Edwards, Robert I. Edwards, Don V. Eells, Merton D. Eggers, Charles D. Ehrengart, Chas. S. Ehrenzeller, John A. Elbe, Edward E. Ellis, Philip Ellovich, Frederick C. Ely, William M. Ely, Fred L. Emerson, Gilbert G. Emerson, Raymond Emery, H. H. Ensworth, Charles W. Eppel, Daniel Eppelsheimer, Wilfrid C. Erdin, A. Wentworth Erickson, Jr., H. J. Erickson, Ralph W. Erickson, Anders G. Ericson, Joseph B. Erkenbrecher, Frederic Ernst, Joseph W. Ernstorff, W. W. Essick, Harry E. Estes, Jr., Charles H. Euler, Lanius D. Evans, Samuel Carroll Evins, John P. Ewald, Charles C. Ewart, Clifford C. Ewing, Hal Kelley Eyster.

Samuel Faber, Dixon Fagerberg, Harry S. Falk, Edgar J. Fallert, F. W. Fallman, John Faraklas, Burt B. Farnsworth, P. T. Farnsworth, S. Edgar Farquhar, William J. Farquharson, Joseph F. Farrell, James S. Fassero, Will Faville, Edwin B. Fawatt, Harlan Fawle, Earl Fears, Jr., Frederic Fears, Harry A. Fee, F. W. Feeney, Ernst Feise, Ben Feldman, Roland H. Ferguson, Asa J. Ferry, Martin D. Fetherolf, John C. Fetterman, John W. Fickenscher, Alfred Fiechter, Ernest G. Fifield, Herold S. Files, Harold M. Fine, Donald Glen Fink, James Finlay, Albert C. Fischer, Herbert H. Fisher, Jr., J. H. Lee Fisher, Malcolm L. Fisher, Roger D. Fisher, Ernest B. Fitzsimmons, John Fladness, Byron Ray Fleck, John

Madison Flemister, F. S. Fletcher, John L. Flores, S. L. Flournoy, Robert A. Follansbee, Candido Fontanetto, John Ripley Forbes, Fred W. Ford, John Ford, Jr., Fred J. Fordrung, L. Gardner Forman, Walter A. Forman, S. Sidney Forst, William Forst, Ben W. Fortson, Jr., Carl H. Foster, H. D. Foster, J. Alton Foster, John Thomas Foster, Ronald M. Foster, Samuel Frank, Ira M. Frankenfield, Curtis Franklin, Thomas H. Fraser, C. Finis Frazier, Stuart D. Frazier, W. A. Freeburn, Samuel Freifield, Roy K. French, Rudolph Freund, Charles Friedman, Frank M. Friend, R. W. Frost, A. J. Fry, C. Allen Fuller, Jr., George Arthur Fuller, J. Kendall Fullerton, Chester Alan Fulton, A. S. Furcron, R. M. Furnell.

Wm. C. Gadda, Gerald Gallagher, J. J. Gallaher, W. E. Gardiner, Nelson A. Garlinghouse, J. Lyndon Garratt, George Garrott, David Garvin, D. L. Gaskill, Charles L. Gatz, L. E. Gearheart, Harry M. Gehman, Joseph F. Gehring, Jacob H. Geise, Herman Geismar, Jay Gerrard Geller, Harry L. Gemberling, Kenneth O. Gemmill, John Frederick Gensley, Jr., Joseph Gentile, A. Paul Gerhart, Louis Gerteis, Walter E. Gertsch, Noble H. Getchell, John H. Gewecke, Nathaniel M. Giffen, Lincoln S. Gifford, Charles H. Gilbert, William S. Gill, Thomas M. Gilland, Howard Gillespy, Roy E. Gilson, Gerald Gimre, Curtiss Ginn, Jr., P. W. Girr, Willard Sherman Girvin, Jr., Jacob Gitelman, Franklin I. Gittins, George W. Glazier, Harold Gleason, T. Allen Glenn, Jr., Otto Gnerich, William P. Godfrey, Fred Godlove, Henry Franklyn Goepfert, Carl J. Goette, Robert Goetz, Arthur H. Goldie, Herbert G. Golding, Edmund Goldmann, Frank J. Goldstein, Harry Allison Goldstein, Charles M. Good, David Goodale, Everett W. Goodhue, Francis Greer Goodman, James A. Gorman, Michael A. Gorman, Arthur T. Gorton, Le Roy F. Goss, Emanuel A. Gottlieb, F. B. Goudy, Harry E. Gough, John B. Gould, Sydney W. Gould, Alfred M. Gouldon, Henry Goulet, Robert Franklin Grady, H. H. Gragg, E. W. Sterling Graham, Jr., G. E. Graham, Stephen V. Grancsay, Peter Edwards Grannis, Richard A. Granquist, Albert L. Grauer, H. C. Gravely, Erwin W. Graves, Chester H. Gray, J. Newell Green, John W. Green, Joseph I. Green, Henry F. Greene, James P. Greene, Louis A. Greene, Edward S. Gregory, Louis R. Gregory, Raymond J. Gregory, J. J. Greiner, Jr., Jerome Griffith, W. M. Griffith, L. F. Griffin, Carl D. Groat, Russell H. Groebe, Anthony Gross, H. M. Grout, Geo. W. Grubb, William J. Gruler, J. P. Grzemski, Philip J. Gucker, Hugh Guenther, Frederick W. Gurney, Felix G. Gustafson, George A. Guthlein, Harolf G. Gutjahr, Norman M. Guy.

Frederick A. Haase, J. A. Haderer, Albert Haertlein, F. W. Hahn, Jr., Irwin Hale, Leroy P. Hall, Oliver C. Hall, Wallace S. Hall, H. T. Hallowell, G. W. Halse, William A. Haman, James L. Hamill, Munroe Hamill, Harry H. Hamilton, C. L. Hand, Frank H. Hankins, Frederick Hansa, Harry L. Hansen, Waldemar G. Hansen, Adolf H. Hanser, John Hanson, J. Haraguchi, E. P. Harding, Emor H. Harding, Magnus S. Harding, Joseph B. Hare, John Clifford Harlan, John Harlin, James A. Harper, John F. Harper, H. L. Harrington, C. S. Harris, Arthur K. Harrison, Fanneal Harrison, James E. Hart, James H. Hart, Maurice Hart, George Downing Hartley, Arthur C. Hartman, Arthur W. Hartwell, Alfred A. D. Hartwig, Robin Haseltine, Charles H. Hassenmiller, Walter S. Hatcher, Frank J. Hause, S. T. Hauser, Schuyler Hawes, Harold S. Hawkins, Wm. Bruce Hawkins, Douglas Hawley, Sherman S. Hayden, Charles F. Hayes, Frank B. Hayner, Frank L. Haynes, George L. Hayward, J. Frank Hayward, C. Bruce Head, Bartlett B. Heard, George H. Heath, F. A. Hebden, James E. Heeley, Richard H. Heep, Charles E. Heidingsfelder, Jr., W. P. Heilman, Joseph Heine, Grover P. Heinzmann, Albert H. Heitmann, Henry Wm. Helbraun, Isaac J. Helfenbein, H. Howell Helger, Samuel S. Henderson, W. E. Henderson, George W. Hendley, Merton Henry, Roger William Henry, William Henry, George H. Henshaw, N. C. Henthorne, Kurt Heppe, Archibald M. Herbert, John Herberts, John B. Heroman, Horace C. Herring, Rudy Heschl, Lloyd Leland Heskett, Ernest E. Hess, H. L. Hess, John A. Hess, Robert H. Hester, Ed. Heston, Gilbert C. Hifner, George W. Hildreth, Anthony Hile, Robert Hill, W. H. Hill, C. R. Hille, Alton F. Hillis, Willard L. Hillyer, Burt Lees Hilton, Leland F. Hinds, John V. Hinkel, John W. Hinkel, Ernest Hippe, Edwin Hirschberg, Frederick Rudolph Hirsh, Jr., Stanley W. Hirtle, Ed. L. Hitchcock, Frederick S. Hitchcock, Joseph M. Hixon Merk Hobson, Carl Hoerz, Alfred L. Hoffman, Caius Marion Hoffman, Geo. E. Hoffman, J. W. Hoffman, William M. V. Hoffman, William Seton Hoffman, Carl O. Hoffmann, Hermann Hoffmann, Adolph Hofstetter, Chester L. Hogan, James F. Hoge, Edward J. Hogg, A. D. Hollingshead, John G. Holmes, John Holmgren, Alfred B. Holt, W. L. Honnold, Carl Hood, Fred J. Hooks, Newman L. Hoopingarner, Chas. W. Hoops, H. L. Hoover, Henry D. Hoover, Amos L. Hopkins, C. R. Horch, Herrmann Horenburger, Morton Horkheimer, Sol. W. Horn, Richard Garfield Horne, Herman G. Hornfeck, Roy H. Hornidge, Jr., H. C. Horton, William Hosking, Roy B. Hotchkiss, Frank Hough, Edward R. Houghton, George E. Houghton, J. A. House, John L. House, Archibald Howard, George B. Howell, A. W. Howland, Malcolm G. Howland, J. Howard Howson, Arthur B. Hoyt, Eugene F. Hoyt, Charles L. Hudson, Robert F. Hudson, Clyde Carlisle Huffman, Edgar F. Hughes, J. Harry Hull, Charles E. Hunt, Henry F. Hunt, Rockwell D. Hunt, Robert A. Hunter, Charles C. Hurst, Paul Huntmann, Wallace Charles Hutton.

R. W. Ilgner, John Illo, Rea Irwin, Carl D. Isaacs, Lawrence J. Isetti.

Fred M. Jackson, Richard L. Jackson, Horace E. Jacobs, Sinclair Sartorius Jacobs, Jr., W. M. Jacobs, J. Pierson James, W. W. Jamison, Frank S. Jarnes, Brooke L. Jarrett, Frederick W. W. Jaxheimer, James Jecha, N. Ashley Jenkins, Aldro Jenks, Jr., Cecil K. Jennings, Lars Peter Jensen, Leslie A. Jessen, Carsten A. Johnsen, Andrew R. Johnson, Arthur E. Johnson, Daniel E. Johnson, D. E. Johnson, E. M. Johnson Frank R. Johnson, Henry C. Johnson, James G. Johnson, Oliver R. Johnson, Paul V. Johnson, R. Johnson, William A. Johnson, A. M. Johnston, H. N. Johnston, Marion K. Johnston, Geo. F. Joly, Jr., Harry V. Jones, Herschel H. Jones, Leonard Jones, Harold D. Judd, Lewis R. Judson, John Jurison.

George Ames Kahmann, Murray G. Kahn, Paul J. Kahn, Vincent L. Kallen, John M. Kane, Anthony Kapitan, Abraham Kaplan, Chas. D. Kaplan, Samuel A. Kaplan, Edward Karl Karklin, David B. Karrick, Louis S. Kassel, Henry Katz, Phil C. Katz, Anthony Kawlaicze, Adolf Keel, Vernon H. Keirstead, Jule M. Keller, Charles M. Kelly, Jr., Lawrence Kelly, Frank M. Kelso, Henry H. Kendall, N. W. Kendall, Gunther Milton Kennedy, John Bernard Kern, W. A. Kern, Stewart Kerr, George T. Kesler, John B. Kesler, Clemens H. Kettenhofen, John Keyes, Robert H. Kidder, Robert L. Killin, Philip N. Killinger, E. G. Kilpatrick, Jr., William H. Kilpatrick, Roy E. Kimball, William Thomas King, Clay Kinsell, Robert S. Kinsey, Bruce Kirby, J. Kirchenstein, Bernard R. Kirchoff, Ralph D. Kiser, Charles M. Kitson, Richard Carr Kitzinger, Frank E. Klecan, Adolph Klein, Frederick Robert Klenner, Eugene F. Kline, Harry L. Kline, Jacob Israel Klinger, Edwin Van B. Knickerbocker, William J. Knorst, Frederick Knowles, Paul W. Koch, Richard Koch, Carl G. Koeppl, Gerald L. Koffel, Viatcheslav V. Koodroff, M. L. Koppelman, H. J. Gustav Kepsch, I. L. Kotler, Frederick L. Kraemer, R. G. Kraft, Philip Kratz, Philip E. Kraus, G. A. Krause, J. W. Krause, F. C. Krieg, Abraham Kroll, Dean Krotter, Paul J. Kruesi, John Krukowski, Henry R. Kubista, A. M. Kuhlmann, Leon Kuhnberg, Evan F. Kullgren, Floyd E. Kurtz, Maurice Kurzman, F. W. Kuster, Nathan Kutcher, Davis M. Kydd.

Emanuel Labes, Frederic W. Lahr, Merritt F. Lamb, Allen B. Lambdin, Arthur W. Lamm, John M. Lancasber, Charles K. Landan, Edward B. Lane, Jonathan T. Lanman, Harry J. Laramee, Jay G. Larson, Geo. E. Lask, M. W. Latimer, George A. Laughlin, G. Francklyn Lawrence, Louis V. Laurents, Carl C. Lavery, Robert Reginald Lawrence, Winthrop Stanley Lawrence, I. Grand Lazzelle, John Lean, Louis S. Leavitt, Robert Jay Lebrecht, Harold F. Lederman, Thomas Lee, Umphrey Lee, Winfield S. Leeth, A. W. Lefeber, Murphy J. Lege, William E. Leidt, Jas. G. Lennox, E. B. Leonard, Leonard Leone, Jr., Adolph C. Lesemann, Jr., John P. Leston, Thomas S. Lever, Donald Romm Levy, Louis Levy, Alvan R. Lewis, E. S. Lewis, Kenneth M. Lewis, Benjamin M. Lewiz, Maxim Lieber, Abraham Leiberman, S. W. Lightle, Louis L. Lincoln, John E. Lind, Roger L. Lindamood, Alfred M. Lindau, Harold E. Lindberg, H. H. Lindley, Charles L. Lindros, Bert Lippner, Plautus I. Lipsey, Jr., Charles Ames Litchfield, A. Walton Litz, John Lloyd, Jr., Gene Lockhart, L. Trerette Lockwood, Simon Loeb, E. H. Loftin, J. C. Logan, Robert R. Logan, Wm. A. Lohman, F. W. Lohr, Paul F. Loichot, Alva C. Loney, Robert S. Loose, Louis H. Lopes, Laurance W. Lord, Oliver Schule Loud, H. E. Lougheed, Nico G. Loupos, Lee Louria, Leon G. Lovan, James Lee Love, Will H. Lovesy, Geo. W. Lowe, Euell A. Lowery, Lloyd W. Lowrey, Frank B. Lucas, F. P. Luckey, Walter Carleton Luckey, P. H. Ludt, Wm. C. Ludwig, Albert L. Luger, Bradford W. Luther, John H. Lynch, John J. Lynch, Paul A. Lynch.

Bruce T. MacCannon, Henry MacDonald, Philip G. MacDonald, Charles Austin Mace, Elmer E. Machamer, Harry E. Mack, Findlay MacKenzie, John R. MacKinney, George Thomas Macklin, Arthur W. MacLean, A. J. MacLeod, Benjamin Ellicott Madden, W. F. Madden, Edward J. Madill, John Mael, Edward Randall Maguire, W. R. Mahan, Emil A. Malmberg, J. E. Maness, Arthur E. Manheimer, Benj. Margulies, Frank Burton Marks, Asher H. Marron, George B. Marsh, Philip M. Marston, D. Martignone, Geo. W. Martin, J. Truitt Martin, Edgar C. Marvel, Walter A. Marx, Alfred N. Maughan, Ernesto Maury, John May, Edward L. Mayberry, Isaac H. Mayer, Charles B. McCann, Henry A. McCarthy, Cyrus H. McCormick, Joseph M. McCowan, Richard McCulloch, E. C. McCullough, Paul Newton McCullough, H. L. McCune, Jr., Gough McDaniels, Ira M. McDonald, J. P. McDonald, Robert J. McDonald, Philip G. McDuffie, Malcolm McDougall, James McEvoy, R. S. McFarland, E. L. McGee, Joseph C. McGoughran, James H. McGraw, John M. McGregor, David McIntyre, Frederick L. McKay, Rufus A. McKenzie, G. M. McKibben, William E. McKinley, A. C. McLaughlin, Elmer E. McMartin, Neil C. McMath, Edward K. McManus, John T. McRoy, Edward Meadowcroft, Milo T. Means, Clarence G. Meeks, Kapindra M. Mehta, Paul Mellon, A. C. Meloney, James A. Meridith, William Benj. Merrel, Edward R. Merrill, F. H. Merrill, August Merz, Charles B. Metz, Alfred C. Meyer, J. G. Meyer, E. T. Meyers, Walter Clyde Middleton, Theodore Midjass, Vicenzo Migneco, Ted Miles, C. G. Milham, Alten S. Miller, Chester A. Miller, George Carlyle Miller, J. Clyde Miller, Jesse Verne Miller, Nathaniel L. Miller, Percy Chase Miller, Wade E. Miller, Wilmot M. Millham, W. S. Minard, George H. Minor, Isaac Herman Mirkin, Charles P. Mitchell, K. T. Miwa, Robert Mixter, J. D. Mocquot, Josiah Moffatt, Thomas S. Moffatt, Jr., M. F. Moffett, Leon Wm. Mofsovitz, Christ Morgensen, John A. Moir, Jr., Daniel D. Molony, W. B. Montgomery, T. Harrison Mooney, Herbert P. Moore, J. E. A. Moore, W. E. Moorehead, Sheldon Morgan, John Watson Morrell, Frank E. Morris, H. L. Morris, Robert H. Morris, Frank A. Morrison, M. J. Morrissey, F. H. Morse, Frank S. Morsman, Louis J. Morton, Charles F. Mosher, L. Kenneth Mosher, G. A. Mote, Walter E. Mote, Ernest F. Mueller, Thomas C. Muir, W. C. Mullendore, Hendrik Statius Muller, Henry W. Muller, Ralph W. Mungle, William D. Munroe, Joseph R. Murphy, Lewis T. Murphy, R. Bradford Murphy, G. H. Murray, C. P. Musgrave, Jas. A. Musil.

Herman W. Nash, C. C. Neeb, Carl E. W. Nelson, G. N. Nelson, Harry Nelson, Jose Xiquena Nelson, Robert G. Nelson, John L. Nesbitt, W. D. Nettleton, Allen M. Thomas Neumann, Benj. Nevius, T. Jefferson Newbold, Jr., Irwin M. Newell, J. L. New-land, Allen T. Newman, S. Mills Newman, C. Malcolm Nichols, N. M. Nicholson, F. J. Nicht, Jens Nielsen, Elmer R. Nightingale, Roy E. Niles, Snga Nilkamhaeng, E. L. Nippolt, Jas. T. Noble, Jay A. Noble, Joseph C. Noethen, Henry S. Nollen, Thos. S. Norfleet, J. F. Norman, Walter E. Norris, William H. Norris, Jr., Edward F. Norton, Edwin Nosek, George E. Nowotny, M. E. Noyes, John B. Nunn, Edwin P. Nutting, Morton Jerome Nyda.

John J. O'Brien, Frank Oclassen, P. A. O'Connell, Asher J. Odenwelder, Jr., I. J. Ohman, John E. O'Keefe, Daniel O'Leary, Jacob Omansky, Edward T. O'Neill, A. B. Openshaw, J. Norman Opie, Charles F. Oppermann, Leonard Ormerod, David L. O'Sullivan, Miguel A. Otero, Ensign Otis, J. C. Overton, J. T. Owen, William Shefield Owen.

Gustave Pabst, Arthur W. Packard, Eugene H. Paige, Roy Painter, A. Ray Palmer, E. A. Palmer, J. Allerton Palmer, L. G. Palmer, Lowell Mead Palmer, Richard N. Palmer, Stewart Palmer, J. Wesley Pape, William A. Papke, Frank Pardee, Foster Jay Parke, Paul F. Parker, Thomas Parran, Jr., Anthony Pasin, Joseph Michael Paszek, F. B. Patterson, Arthur O. Paulson, Robert O. Pawling, J. H. Cameron Peake, Thomas C. Pearson, Pedro Paz, Harry J. Pedersen, Arch Pendleton, Albert N. Penn, George F. Perkins, Prescott D. Perkins, Roger G. Perkins, John M. Pero, Edward Delavan Perry, Marvin B. Perry, James F. Person, George Pert, E. C. Peters, John Peters, P. B. Peters, Arthur F. Peterson, J. Livingstone Peterson, W. J. Peterson, Frederick Petranowitz, L. L. Pettengill, Bernard Peyton, J. C. Peyton, E. C. Pfeffer, Lloyd Phelps, H. E. Philip, Samuel F. Phillips, Minot C. Pichon-Smith, Albert J. Pickford, Harry W. Pier, H. J. Pierce, Laurence W. Pierce, Alvin Pieritz, Wallace J. Pierpont, James H. Pillow, Robert L. Pines, R. W. Pingle, Anton Pinter, John Q. Pitchford, Winfield B. Place, M. A. Pleasure, Louis W. Ploger, Richard H. Pochat, Edward Pole, George W. Polk, Jr., Selig Pollack, J. A. Pollock, Nelson Polsky, Floyd C. Pool, Dorian Z. Poole, Wm. B. Poor, Edward Poppe, W. S. Posey, Clifford Weston Poteet, Fred W. Potter, H. S. Potter, Chas. S. Potts, Thomas H. Powell, Francis W. Powers, Frederic R. Pratt, Wm. A. Prendergast, Franklin L. Prestidge, Alfred D. Preston, John W. Preston, Clinton B. Price, Edward F. Price, Peter Prine, Henry M. Propper, E. W. Pruitt, Frank Pull, John David Pults, Clarence O. Putnam, Edwin D. Putnam, George Putnam.

Augustin L. Queneau, Cyris F. Quick, Edward Quirin, M. B. Quivey.

Sy Rabin, C. G. Raible, Harry A. Rame, Chas. D. Randall, Jay E. Randall, Edwin H. Ranges, Julius M. Rapoport, Samuel Rappaport, Samuel J. Rashid, Staley M. Rathbun, Cliff Ratliff, Joseph J. Reading, Frank H. Reagan, Charles A. Reber, John H. Redd, Jr., Horace W. Reed. Philip C. Reed, A. R. Rees, M. A. Reese, Elmer Z. Reeve, George H. Reeves, Jr., E. F. Regan, Harry C. Regan, James D. Regan, Leslie Reggel, Harald A. Rehder, Russell Reid, D. Kenneth Reimers, Ralph D. Remley, John F. Renick, William A. Reynolds, G. E. Rhoads, Alfred Riani, Lawrence Richards, Alphyon P. Richardson, Cecil C. Richardson, Creel Richardson, J. L. Richardson, E. L. Richmond, George L. Richmond, Edward Ricketts, Jr., E. T. Ridgeway, Seth F. Rigby, D. F. Riherd, Charles A. Rinde, Robert Treat Rinear, Leon Rintel, Jose A. Rivera, Donald J. C. Robertson, Percival Robertson, William Hall Robertson, Max B. Robins, Duane L. Robinson, Edward Cummer Roe, H. Harvey Roger, Stanley I. Rohrbach, Henry H. Rolapp, Charles M. Romano, J. E. Romm, Eli A. Ronnback, E. C. Rood, William J. Rooney, M. Wesley Roper, Homer D. Rose, Allen Rosenbaum, Joseph Rosenfield, Jr., E. Wm. Rosevear, George Ross, John A. Ross, Chas. A. Rouiller, Peter Sturgess Ruckman, Alexander G. Rudel, Frederick H. Rundall, Geo. L. Rupe, Willard W. Rusk, Alfred R. Russell, Harry N. Russell, W. D. Russell.

Theodore Safford, J. I. Sager, Seaton Sailer, John Salacki, John E. Sammond, Chas. N. Samons, C. C. Sampson, Eugene Wm. Sandbloom, Paul H. Sanders, Clarence Herbert Sanderson, S. Wyatt Sanford, Conrad J. Saphier, Dickran M. Sarkisian, Benj. Satran, Jr., Warren S. Saunders, Wm. A. Saunders, Edwin F. Savage, Philip J. Savage, Walter J. Savage, Harry E. Sawyer, Wilbur H. Sawyer, Morris Sayre, Michael J. Scanlon, W. Stanley Schaefer, John J. Schafer, D. C. Scheffler, A. P. Scheld, H. W. Scherer, Fred M. Schellhammer, R. M. Schiele, Arthur Schlegel, Paul Schlender, Carl D. Schlitt, Verne F. Schlosser, Jesse E. Schmick, Edward C. Schmidt, R. L. Schmitt, Gustavus A. Schnabel, James T. Schoenbrod, Emil O. Schott, W. A. Schreiber, Fred F. Schuck, G. Garrett Schuler, Geo. H. Schuler, Daniel Schultheis, Peter V. R. Schuyler, Jr., Frederick A. O. Schwarz, Abraham Schwartz, Oscar D. Schvartz, Edgar H. Schwarzenbach, Joseph Schwarzenbach, Walter W. H. Schwedler, E. W. Scott, Hall E. Scott, Philip D. Scott, William Scott, Paxtor G. Seabury, Henry E. Sealey, Willard James Seder, John W. Seiden, J. Fred Seitz, R. W. Senger, Reginald A. Seagrave, Fred W. Senning, David Sessler, George Steele Seymour, Gideon Seymour, Robert A. Sforzini, S. S. Shattuck, Harry A. Shaw, Albert J. E. Shay, Thomas Shea, Jr., Christopher C. Sheats, Jr., L. W. Sheets, D. D. Shepard, Emmett G. Sheppard, J. Q. Sherman, F. W. Shields, Louis Tad Shima, James D. Shinkle, James Angus Shirras, Boris N. Shnitnikoff, David O. Shoemaker, Clarence A. Short, Stanley R. Short, G. T. Sibley, James M. Sicilians, George B. Sickel, Francis B. Silsbee, P. F. Simon, Mortimer L. Simpson, Richard L. Simpson, Dan Sims, T. A. Sims, E. W. Sinclair, H. K. Shearer, Arthur Lawrence Shepard, V. E. Shepherd, John C. Sherman, L. C. Shipherd, Paul T. Shultz, Jr., Robert L. Shurr, Ben Siedsma, Noa B. Sisk, George Henry Sivel, Charles T. Skarolid, William B. Skelton, C. F. Skyhock, Jim Slack, Frank D. Slade, A. Slater, Joseph L. Slater, D. N. Slep, William E. Sloan, Jr., James C. Smillie, Andrew H. Smith, Cedric Ellsworth Smith, Dudley H. Smith, Edward W. Smith, Jr., Frank E. Smith, Frank G. Smith, George Harris Smith, Harry James Smith, Harry T. Smith, Horace F. Smith, Jr., Leon L. Smith, Maitland L. H. Smith, Robert Shufeldt Smith, U. S. Smith, William A. Smith, Frederic S. Snyder, James E. Somers, William Somerville, Jr., Harry J. Sommer, William H. Sommer, Chas. E. Sones, Leroy J. Sonier, Andrew Sonsthagen, Arthur Soronen, R. E. Souers, Roe Thayer Soule, Frederick A. Southmayd, John E. Sowter, Peter Spalding, Jr., Frank H. Speese, Edward G. Sperry, Chas. Spillane, Fred Spivey, Arthur W. Spolander, Leo C. Sprague, Lombard Squires, Walter Albert Stanbury, Oscar E. Stanton, J. D. Stay, Alfred B. Stebbins, Edward Steen, Edward Stein, Albert Stenmo, Lawrence A. Stephens, Charles L. Stephenson, William M. Sterrett, Dallas H. Stevens, James Stevens, John Bright Stevens, Fred G. Stevenson, Audley D. Stewart, Gilbert L. Steward, Jr., James H. Stewart, Truman Stewart, Lou Stierer, Albert I. Stiles, Henry B. Stimson, Charles J. Stinson, R. A. Stirton, John Bell Stivers, Theo. E. Stivers, Joseph H. Stock, J. D. Stocker, Marvel M. Stockwell, Russell B. Stoddard, A. Wilfred Stone, Edward N. Stone, Murray Stone, Harold T. Stowell, Herbert R. Straight, Robert L. Straker, Gordon L. Strand, Louis Strand, Thomas Fulton Stretton, Wm. Boothby Stringfellow, Jr., Frank E. Strom, F. S. Strong, Jr., H. L. Strong, William B. Strong, S. C. Strunz, Charles W. Stuyvesant, Charles W. Sudbrenk, Oswald N. Suksdorf, Jerry B. Sullivan, J. L. Sullivan, J. H. Super, Neil R. Sutton, Felix Svereika, Norman Nygaard Swann, Arthur Swanson, Carl V. Swanson, A. Swanstrom, J. R. Sweeney, Justin W. Swenson, W. G. Swenson, George A. Swertfager, Raymond E. Swett, Paul D. Swift, William Everett Swift, Jr.

George H. Taber, J. W. Taggart, R. J. Tague, Emmett D. Talbot, Wm. Talbot, Richard T. Talpey, Louis Tancrede, D. L. Taylor, E. Stanley Taylor, Edwin C. Taylor, Goodwin M. Taylor, John C. R. Taylor, K. Wentzel Taylor, Ralph W. Taylor, W. S. Taylor, Phil Tead, Charles H. Teas, J. C. Templeton, Edward B. Tenney, J. L. Tete, B. M. Thoens, J. R. Thomas, Paul Thomas, Rollin Henry Thomas, Jr., J. Charles Thompson, L. B. Thompson, Richard C. Thompson, Carl Thomsen, T. C. Thornhill, Albert E. Thornley, Irving T. Thornton, Richard B. Thrift, L. Ray Thurston, Neal Thurman, Paul Tison, Carl H. Tjarks, Charles G. Todd, W. E. Tollenaar, Daniel D. Tompkins, Theron Alfred Tompkins, P. S. Toney, Wm. W. Tonner, Alphonse T. Tonietti, Merle F. Tooley, Bernard M. Toomey, J. H. Torline, Lansing W. Tostevin, Harold M. Towne, Rufus Avery Tracy, Jr., S. W. Tracy, Bernard H. Trager, Eugene S. Trask, Herbert F. Traut, Richard W. Trefz, Warren H. Treichler, William R. Trigg, Homer S. Tripp, A. P. H. Trivelli, John Trounstine, Elliott S. Tucker, Harold W. Tucker, J. H. Tucker, Jr. John H. Tucker, Jr., Wm. E. Tucker, Ronald B. Tukey, Gordon H. Tully, Irby Turnbull, F. G. Turner, Robert W. Turner, V. Y. Tuttle, A. H. Twitchell, Vernon J. Twyning, Jesse E. Tyler, W. Perry Tyson.

Philip C. Ulanoff, Arnold J. Ullstrup, I. J. Underwood, John F. Updegrove, Grover W. Utzinger, Herbert Gilson Vail, Harris H. Valenstein, Wm. C. Vandenberg, H. A. Van der Linden, Nicholas Vander May, Arthur F. Van Dewater, Floyd C. Van Eps, Stephen Van Fleet, Gysbert Van Steenwyk, Albert C. Van Tine, Jr., John J. Van Vliet, Henry F. Van Winkle, Irving Van Zandt, George T. Vaules, Herman J. Veeck, John S. Vermilye, Cecil E. Viles, Chas. Voegeh, Henry Vogeler, Lloyd E. Volk, Hermann Erich von Corp, James A. von der Heydt, Christopher H. von Glahn, I. James von Sholly, Charles William Voris, John M. Vorys.

F. E. Wabel, Walter Wachter, Oliver C. Wademan, Raymond F. Wagner, Samuel T. Waidelich, James O. Wails, Roy Wain, Jindrich Waldes, C. G. Walker, Uel M. Walker, R. J. Walker, Sylyan E. Wallen, Waldemar Wallner, Patrick J. Walsh, Phillip T. Walters, Marcus L. Ward, Malcolm C. Ware, John Warne, C. E. Warner, Jr., Eugene E. Warner, Fred C. Warner, Frederick H. Warner, J. H. Warner, Mason Warner, Ebert K. Warren, F. A. Warren, Oscar Wartemann, Carleton Washburne, A. A. Wasserscheid, John Wataha, G. W. Waterbury, Glen M. Waters, L. C. Watkins, John C. Watrous, Ralph L. Watson, Thomas R. B. Watson, Homer A. Watt, William W. Wattenberg, Pauline Weaver Curtis A. Weber, J. C. Weirick, Ben Weisman, Loyal W. Weitz, B. D. Weeks, G. W. Weeren, Edward I. Weinroth, Paul G. Weitz, Francis W. Welch, Jr., W. Earl Weller, Fred C. Wells, Howard M. Wells, James D. Wells, Lloyd L. Wells, Ernest Wellington, Earl R. Welliver, William Henry Welsh, A. S. Welter, Everett J. Wendell, Benjamin H. Wender, Allen R. Wentz, Stanley Werdell, Lewis N. Wesch, Robert Flagg Wessman, Carlton P. West, F. Howard Westcott, Gordon S. Westlake, Walter H. Wetton, Winton Weydemeyer, William Wheeler, Charles C. Wheelwright, Frank R. Whelan, Andrew J. Whinery, Ivan Whisler, Joel H. Whitaker, Paul S. Whitcomb, Grady Whiteley, Wm. L. Whitfield, David C. Whitney, Walter Stanley Whitten, E. W. Wiese, Franklin M. Wilber, D. W. Wilcox, John L. Wilcox, F. Richard Wilke, Howard E. Wilkening, Charles E. Willets, Alonzo Williams, Fred C. Williams, Frederick Peck Williams, Gerald C. Williams, John Roger Williams, Otho H. Williams, Glenn S. Williamson, Leroy B. Willie, Frank Wilmot, Ernest H. Wilson, K. P. H. Wilson, Ralph B. Wilson, Jr., Robert K. Winning, Donald Winsor, William D. Winter, J. B. Witherspoon, W. J. Witt, Alfred A. Wohlauer, Walter William Wolf, Edward M. Wolfe, Eugene Wolfe, Benjamin Wolff, Herbert W. Wolff, Charles Henry Wood, Chas. L. Wood, Eleanor M. Wood, George C. Wood, Frederick W. Wooding, A. B. C. Woodman, Arthur K. Woodman, Alvyn L. Woods, H. A. Woods, Edwin G. Woolley, Jr., Frederic E. Worden, Homer E. Work, William Carson Worley, J. H. Worrall, Jr., James C. Wright, W. McK. Wright, Joseph Richard Wunner, Charles S. Wyckoff, W. I. Wymond.

O. Yamamoto, Edward Yeomans, Jr., Forest A. Yoas, O. R. Yoder, John M. Young, Harry Yuralta.

Robert L. Zabriskie, A. S. Zachary, J. Hillman Zahn, John E. Zahn, Foster L. Zeh, Howard Y. Zeller, Carl Otto Zerrahn, Rudolf Zimmer, A. J. Zimmermann, Bernard Zitin.

YOU CAN BELIEVE
these Fish Stories

The World of Fishes

by WILLIAM KING GREGORY
and FRANCESCA LAMONTE

A KEY TO CHAOS

The jumbled confusion of fishes reduced to a few simple, comprehensive groups.

Everyday fishes treated as living engines
Flying fishes as gliders
Fantastic deep-sea fishes
Parental care in fishes
Evolution of fishes in Geologic Time

90 pages, 18 illustrations. Paper bound.
Price 30 cents post-paid

Address orders to THE LIBRARY

THE AMERICAN MUSEUM
OF NATURAL HISTORY
77th Street and Central Park West
NEW YORK, N. Y.

All payments must be made in advance

INDIANS OF THE SOUTHWEST

By PLINY EARLE GODDARD

Offers a review of the facts concerning both the historic and prehistoric aboriginal inhabitants of that well known part of the United States properly spoken of as the Southwest. The author spent much time among the present survivors of these primitive peoples and draws a clear and understanding picture.

205 pages, maps and many illustrations.
Bound in cloth. 85 cents, postpaid.

Address orders to THE LIBRARY
THE AMERICAN MUSEUM OF
NATURAL HISTORY
77th Street and Central Park West, New York, N. Y.

All Payments must be made in advance

SEND YOUR SPECIMENS *by* RAILWAY EXPRESS

For years the nation-wide organization of Railway Express has cooperated with curators and collectors in the transportation and delivery of natural history specimens. Railway Express provides swift transportation at passenger train speed with maximum safety throughout. Pick-up and delivery service in all principal cities and towns without extra charge.

For service or information telephone the nearest Railway Express Agent.

The best there is in transportation

SERVING THE NATION FOR 96 YEARS

**RAILWAY
EXPRESS**
AGENCY, INC.

NATION-WIDE RAIL-AIR SERVICE

BOOKS BY MUSEUM AUTHORS

for sale by THE AMERICAN MUSEUM OF NATURAL HISTORY

Akeley, Carl and Mary Jobe	Adventures in the African Jungle	$3.00
	Lions, Gorillas and Their Neighbors	2.50
Akeley, Mary Jobe	Carl Akeley's Africa	5.00
Andrews, Roy Chapman	Across Mongolian Plains	5.00
	Ends of the Earth (1st edition 1929)	4.50
	Ends of the Earth. (Star edition)	1.00
	On the Trail of Ancient Man	6.00
	Whale Hunting with Gun and Camera	5.00
Andrews, Roy Chapman and Yvette Borup	Camps and Trails in China	5.00
Anthony, H. E.	Field Book of North American Mammals	5.00
Bartlett, "Bob" Sails Over Ice		3.00
Beebe, William	The Arcturus Adventure	7.50
	Beneath Tropic Seas	3.50
	Galapagos, World's End	6.00
	Jungle Days	3.00
	Pheasant Jungles	3.00
	Half Mile Down	5.00
Beebe, William and Tee-Van, John	Field Book of the Shore Fishes of Bermuda	3.50
Brand, A. R.	Songs of Wild Birds. (Has two phonograph records, songs of 35 birds)	2.00
Breder, C. M., Jr.	Field Book of Marine Fishes of the Atlantic Coast	5.00
Carr, William H.	Glimpses of Familiar Birds	1.00
	The Stir of Nature	2.50
Chapman, Frank M.	Autobiography of a Bird-Lover	3.75
	Bird-Life	4.00
	Bird Studies with a Camera	3.00
	Camps and Cruises of an Ornithologist	4.00
	Color Key to North American Birds	4.00
	Handbook of Birds of Eastern North America. 2nd Revised Edition. 1932	5.00
	My Tropical Air Castle	5.00
	Our Winter Birds	2.00
	The Travels of Birds	.76
	What Bird is That?	1.50
Clark, James L.	Trails of the Hunted (First Edition)	4.00
Coates, C. W.	Tropical Fishes for a Private Aquarium. (Tropical Fishes as Pets)	2.00
Curran, C. H.	The Families and Genera of North American Diptera	7.50
Darwin, Leonard	What is Eugenics?	.50
Ditmars, Raymond L. & Carter, Helene	The Book of Zoography	2.00
Grant, Madison	Passing of the Great Race	$3.50
Gray, Prentiss N.	Records of North American Big Game	10.00
Green, Fitzhugh	Roy Andrews — Dragon Hunter (A book for boys about Dinosaurs and Bandits)	1.75
Gregory, William King	Our Face from Fish to Man	5.00
	Man's Place Among the Anthropoids	2.50
Haring, H. A.	The Slabsides Book of John Burroughs	2.50
Johnson, Martin	Cannibal-Land	1.00
	Lion	5.00
	Safari	5.00
Johnson, Osa Helen	Jungle Babies	1.75
Karazin, N.	Cranes Flying South	2.50
Kunz, George F.	The Magic of Jewels and Charms	8.50
	Rings for the Finger	8.50
Lederer, N.	Tropical Fish and their Care	2.50
Leigh, W. R.	The Western Pony	10.00
LaMonte, Francesca and Welch, Micaela	Vanishing Wilderness	2.50
Lorimer, Frank and Osborn, Frederick	Dynamics of Population	4.00
Lutz, Frank E.	Field Book of Insects	3.50
McCreery, James Lindsay	Exploring the Earth and Its Life	2.00
McSpadden, J. Walker	To the Ends of the World and Back. Scouting for a great Museum (The American Museum of Natural History)	3.00
Mann, Paul B., and Hastings, Geo. T.	Out of Doors. A Guide to Nature	2.00
Mason, Gregory	Columbus Came Late	4.00
Mead, Margaret	Coming of Age in Samoa	3.00
	Growing Up in New Guinea	3.50
	The Changing Culture of an Indian Tribe	4.50
Medsger, Oliver P.	Nature Rambles *Spring*	2.00
	" " *Summer*	2.00
	" " *Autumn*	2.00
	" " *Winter*	2.00
Morden, William J.	Across Asia's Snows and Deserts	5.00
Murphy, Robert Cushman	Bird Islands of Peru	6.00
Nichols, J. T. and Breder, C. M., Jr.	The Marine Fishes of New York and Southern New England	$1.40
Noble, G. Kingsley	The Biology of the Amphibia	5.00
Osborn, Henry Fairfield	Cope: Master Naturalist	5.00
	Evolution of Mammalian Molar Teeth	2.75
	Creative Education in School, College, University and Museum	2.50
	The Earth Speaks to Bryan	1.00
	Evolution and Religion in Education	2.00
	Fifty-Two Years of Research, Observation and Publication, 1877–1929	1.50
	From the Greeks to Darwin	2.50
	Impressions of Great Naturalists	2.50
	Man Rises to Parnassus. 2nd Edition	3.00
	Men of the Old Stone Age. 3rd Edition	5.00
	The Origin and Evolution of Life	4.00
Reeds, Chester A.	The Earth. Our Ever-Changing Planet	1.25
Schwesinger, Gladys C.	Heredity and Environment	4.00
Simpson, George Gaylord	American Mesozoic Mammalia	5.00
	Attending Marvels. A Patagonian Journal	3.00
Stefansson, V.	My Life with the Eskimos — New and Abridged Edition	2.50
	The Friendly Arctic	6.50
Vanderbilt, William K.	Across the Atlantic with *Ara.* Summer 1924	5.00
	15,000 Miles Cruise with *Ara.* 1927	5.00
	Taking One's Own Ship Around the World	30.00
	To Galapagos on the *Ara*	30.00
	West Made East with the Loss of a Day	20.00
Walker, Edith B. and Mook, Chas. C.	Tales of the First Animals	1.50
Wissler, Clark	The American Indian	5.00
	Introduction to Social Anthropology	3.50
	Man and Culture	2.75
	Relation of Nature to Man in Aboriginal America	3.50
	Boy Scout Book of True Adventure	2.50
	The Earth, the Seas and the Heavens. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00
	Fishes, Insects and Reptiles. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00
	Mammals and Birds. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00

Address orders to The Librarian

THE AMERICAN MUSEUM OF NATURAL HISTORY
77th STREET AND CENTRAL PARK WEST :: :: :: NEW YORK, N. Y.

Remittances must accompany all orders — Include 10 cents per volume for postage

NATURAL HISTORY

URNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

FIFTY CENTS JUNE 1935

A PROFESSIONAL MICROSCOPE for the NATURE STUDENT

Model HH, from $83.00

Since all we know of the natural sciences is based on discoveries made with the microscope, this instrument is the prime requisite of the seriously interested student of nature. But only a *good* microscope will give a *truthful* image.

Model HH is a standard, professional model fully equipped for the work you will do. All standard optics and accessories can be used with it. Write for complete literature and prices.

BAUSCH & LOMB OPTICAL CO.
142 BAUSCH STREET ROCHESTER, N. Y.

HAY FEVER

ASTHMA and SUMMER COLDS are unnecessary. Complete relief only $1.00 Postpaid. Nothing else to buy. Over 40,000 HOLFORD'S WONDER INHALERS sold last year alone. Mail $1.00 today for full season's relief to THE DANDEE CO., 252 HENNEPIN AVENUE, MINNEAPOLIS, MINNESOTA, or write for Free Booklet.

A unique new volume

WILD BIRDS AT HOME

By
FRANCIS HOBART HERRICK

The fullest account available of the nest-life and habits of American birds — the period of mating, nest-building, and care of the young — illustrated by some of the most remarkable photographs of birds in action ever taken. A volume to delight all bird-lovers and scientists, by the distinguished author of "The American Eagle" and "Audubon, The Naturalist." Over 100 photographs and numerous drawings and diagrams. *At all book-sellers $4.00.*

D. APPLETON-CENTURY COMPANY
35 West 32nd St., New York City

EXPLORE *the* FOREST WILDERNESS

This Summer with the American Forestry Association's

TRAIL RIDERS *of the* NATIONAL FORESTS

THREE GREAT TRIPS

JULY — The Flathead — Sun River Wilderness of Montana.

JULY-AUGUST — The Wind River Wilderness of Wyoming.

AUGUST — The Gila Wilderness of New Mexico.

YOU GO AT ACTUAL COST!

Beyond all roads — See Virgin Forests, unnamed lakes, big game in its native haunts. Fish where few have fished before.

For complete information write

THE AMERICAN FORESTRY ASSOCIATION
1727 Kay Street Northwest
Washington, D. C.

NOOTKA MAN IN CEREMONIAL DRESS WEST COAST OF VANCOUVER ISLAND BRITISH COLUMBIA

The illustrations in "Natural History" are printed from "Sterling" engravings. "Sterling" has served advertisers, printers and publishers with high quality printing plates for over thirty years

COLOR PROCESS—BLACK AND WHITE—BEN DAY—LINE

STERLING ENGRAVING COMPANY
304 EAST FORTY-FIFTH STREET, NEW YORK
TELEPHONES: MURRAY HILL 4-0715 TO 0726

NATURAL HISTORY

The Journal of the American Museum of Natural History

VOLUME XXXVI ★ ★ ★ ★ JUNE 1935

The Gyrfalcon Strikes . . . . *Cover*

From a Drawing by George F. Mason (See Page 81)

"Shiprock" . . . . *Frontispiece*

Sinclair Dinosaur Expedition, 1934 . . . . Barnum Brown 3

Excavations in the Great Jurassic Dinosaur Quarry of Northern Wyoming 140,000,000 Years Old

Bronze Artists of West Africa . . . . Laura C. Boulton 16

The Natives of Benin and Ife — Their Beliefs, Customs, and Art Forms

A Contribution to Maya Architecture . . . . Clarence L. Hay 29

Rio Bec "B" — A Temple in Yucatan Is Restored in Miniature at the American Museum

The Four-eyed Fish . . . . G. Kingsley Noble 34

A Fish that Sees Both Above and Below the Water Surface

Exploring the "Mighty Chindwin" . . . . Arthur S. Vernay 37

The Adventures of an American Museum Expedition in Inner Burma

Winged Monarchs of the Air . . . . George G. Goodwin 51

Falcons — Birds That Have Been Trained Since Ancient Times for a Fascinating Sport

Weaving in the Land of the Incas . . . . Wendell C. Bennett 62

The Extraordinary Artistic and Technical Products Created in Pre-Spanish Peru

Friday Harbor's Nets and Dredges . . . . Harriet Geithmann 73

Harvesting Marine Life from the Waters of Puget Sound for Study at the Biological Laboratories of Friday Harbor

Science in the Field and Laboratory 81

Current Events in the World of Natural History

Reviews of New Books 85

Recent Publications for Those Interested in Nature

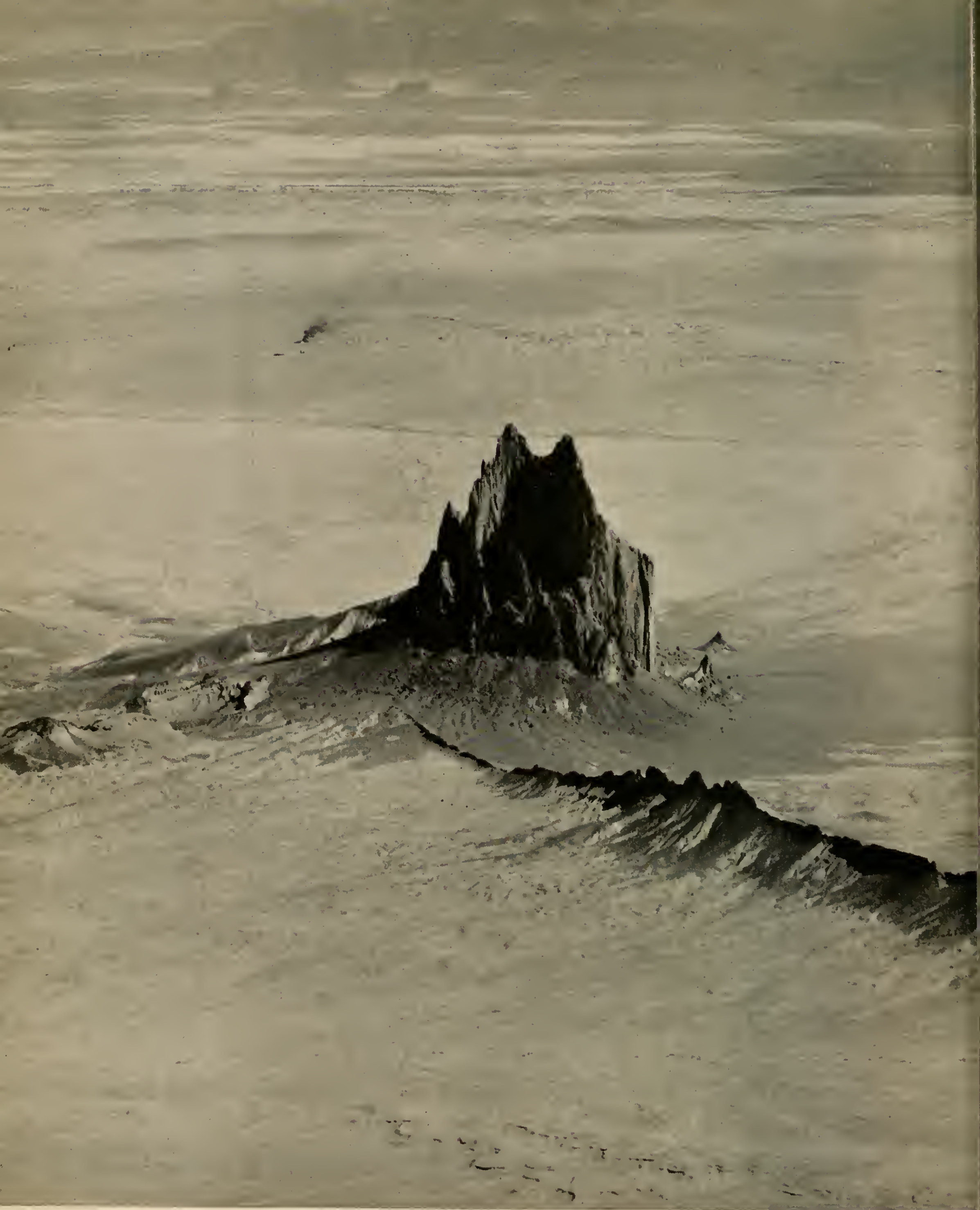
Editorial: Edward M. Weyer, Jr., Editor; A. Katherine Berger, Associate Editor; Dorothy L. Edwards.

Manuscripts should be sent to the Editor, The American Museum of Natural History, New York, N. Y.

Subscriptions: Natural History is sent to all members of the American Museum as one of the privileges of membership.

Advertising: Tom Davin, Manager of Publications, The American Museum of Natural History. Publication Office: 10 Ferry Street, Concord, N. H.

Copyright, 1935, by The American Museum of Natural History, New York, N. Y.



© Barnu

“Shiprock”

So named because of its fancied resemblance to a ship under full sail, when seen at a distance. It is a volcanic plug, 1300 feet from base to summit. A lava dike shows in the foreground.

Smoke from Rattlesnake oil field, and the Carriso Mountains are visible in the distance.

This photograph was taken at an elevation of 2000 feet, during Sinclair aërial survey in the valley of the San Juan, thirty-five miles west of Farmington, New Mexico

Sinclair Dinosaur Expedition, 1934

Excavating the great Jurassic dinosaur quarry of northern Wyoming, 140,000,000 years old

By BARNUM BROWN
Curator of Fossil Reptiles, American Museum

Photographs by the author and party

DINOSAURS pique the imagination of the beholder as do no other creatures past or present. They are usually so large and differ so markedly from modern animals as to cause one to pause and wonder.

Especially is this true of the huge Sauropods whose skeletons are of gigantic proportions. To the collector they usually mean lots of hard excavation work and long tedious hours of laboratory preparation before they can be seen by visitors; rarely is it possible for the general public to see these remains in the field or to participate in the thrills of discovery and field preparation, which is frequently as significant as the anatomical study of the specimens.

The Dinosaur Expedition of 1931 had worked intensively in the Lower Cretaceous beds of Montana, chiefly on the Crow Indian Reservation, on the outer flanks of the Big Horn and Pryor Mountains, where fourteen skeletons of Cretaceous dinosaurs had been excavated. The following year exploration was continued on the inside of the Big Horn Basin. We had followed these Lower Cretaceous beds southward as far as the vicinity of Greybull, Wyoming, where Mrs. M. L. Austin, an enthusiastic local collector, told us of large bones she had seen on the Barker Howe Ranch.

Exploration in 1934

Traveling eastward from the Big Horn River, we followed up Shell Creek sixteen miles, then northeastward along country roads over dark-colored ocean sediments that from horizontal strata increasingly tilted upward, with beds of oyster shells on either side as we approached the mountains, the last four miles being a meandering trail along a knife-blade "hogback" that no auto driver would possibly call a boulevard.

The scenery is magnificent, — white limestone mountains several thousand feet high, rolling abruptly upward to the eastward, with a narrow red band at their base and gashed by sharp, narrow, red-tinted cañons with jagged granite peaks of the central mountain core occasionally breaking through. Brilliant blue, red, and purple clays cap many of the fantastically sculptured hilltops.

Finally we reached our destination at the base of the mountains a thousand feet above the Big Horn Valley.

Bones on the Howe Ranch

The Howe Ranch is located at the very foot of the Big Horn Mountains near the original Cloverly Post Office, twenty-five miles northeast of Greybull, and twenty-five miles south of the Montana line. Barker Howe had long known of the large bones weathered out on one of his hillsides, and he had taken several of the larger pieces to the ranch buildings — the large bones exciting his wonder as to what kind of queer creature they represented.

On arriving at the Ranch, we found Barker (a young man of eighty-two years) stacking alfalfa hay. He was interested at once when large bones were mentioned, and stopped work long enough to show us the hillside where bones were exposed. During the week of our prospecting, he neglected hay work entirely in order to watch us and speculate on the prehistoric past; he wanted to rip out the bones with a big pick and we found it difficult to keep him from digging, for in his opinion we were very slow workers.

Bones were exposed in three places under a thick stratum of sandstone; in the course of a week we had uncovered what appeared to be parts of two connected Sauropod skeletons — fourteen connected tail vertebræ of one specimen, joined to the sacrum; and a hind leg with several connected tail bones of the other. As near as we could determine, the bones were but little crushed and several features indicated that they were different from described species. The bone layer was a clay stratum two feet thick, overlying a continuous hard sandstone, and covered by six feet of sandstone.

My companions, Mr. P. C. Kaisen and Darwin Harbicht, who are seasoned bone-diggers, agreed with me that under such conditions, with only three men, we could not hope to excavate two large skeletons of this kind in the remaining part of the season. Reluctantly we covered the prospect against rain and curious people, until we could have a force and the time necessary to excavate the specimens. Howe promised to guard them until we returned.

In 1933 our appropriation for field work was limited to a small sum — only sufficient for me to go out alone and hire teams and local help to remove the six feet of sandstone overlying the skeletons, an area 65 x 45 feet — leaving a little sandstone and the clay layer to protect the specimens.

The Sinclair Expedition

In 1934 there was no Museum appropriation for field work, but fortunately, the Sinclair Refining Company, which has for some time used dinosaurs as a symbol for their products, generously coöperated by supplying funds for our expedition.

Owing to the unusual amount of publicity given to this expedition, there were many applications to join our party. Eventually the personnel was selected, with Carl C. Sorensen in charge of the work, and during the season the party averaged from nine to twelve people. A tent camp was established near the quarry on the Howe Ranch and excavating started on June 1st.

The entire area was carefully uncovered; first with team and scraper, big picks and shovels, then with prospecting picks, awls, whisk brooms, and fine brushes, as the bones were gradually laid bare; a continuous process of cleaning.

It soon became apparent that, instead of two skeletons, there was a veritable herd of dinosaurs, their skeletal remains crossed, crisscrossed, locked, and interlocked, in a confused and almost inextricable manner. To one not acquainted with such deposits it seemed a bewildering and hopeless confusion. Indeed, it would have been impossible to associate the parts of individual specimens with any degree of certainty had the matrix been sandstone instead of clay. Had this deposit been in sandstone, it would have taken years to remove the same amount of material.

Through the warping of the strata incident to the near-by mountain uplift, the bones had been checked and fractured to a high degree, so all had to be thoroughly shellacked as soon as uncovered. Never have I seen such a thirsty lot of dinosaurs. As soon as a bone was shellacked, it was left to harden, and a man would move to a new section to repeat the process. Thus, often at the end of a day, the work of the entire party could scarcely be detected.

Gradually the bones assumed definite form, and the entire area was laid off in three-foot squares, each of which was numbered, and the bones accurately drawn within the squares on quarry charts. Eventually the bones were plastered, and each bone, or block, given its square number, thus making definite association possible when the specimens are prepared in the laboratory.

Our camp trail over the rough country was improved, and over this road came a constant stream of cars: thousands of visitors from all parts of the United States and a few from Europe. From early morning until late at night they came, sometimes during the night, many repeating their visits as the work progressed. So many visitors lost their way on side roads that signs were placed along the trail, but they were soon taken by souvenir hunters — one day a rib came in the mail, sent anonymously by some conscience-stricken visitor.

Although it was inconvenient at times, we were glad to show the quarry to visitors and schools, for never have I uncovered a more interesting deposit of prehistoric remains or seen one where the story of their death and entombment could be read with such clarity.

As soon as we had established the character of this assemblage of many individuals, it became clear that the relationship of body sections must be determined *in situ* before any bones could be removed. Up to August 1st, therefore, not a single bone had been excavated.

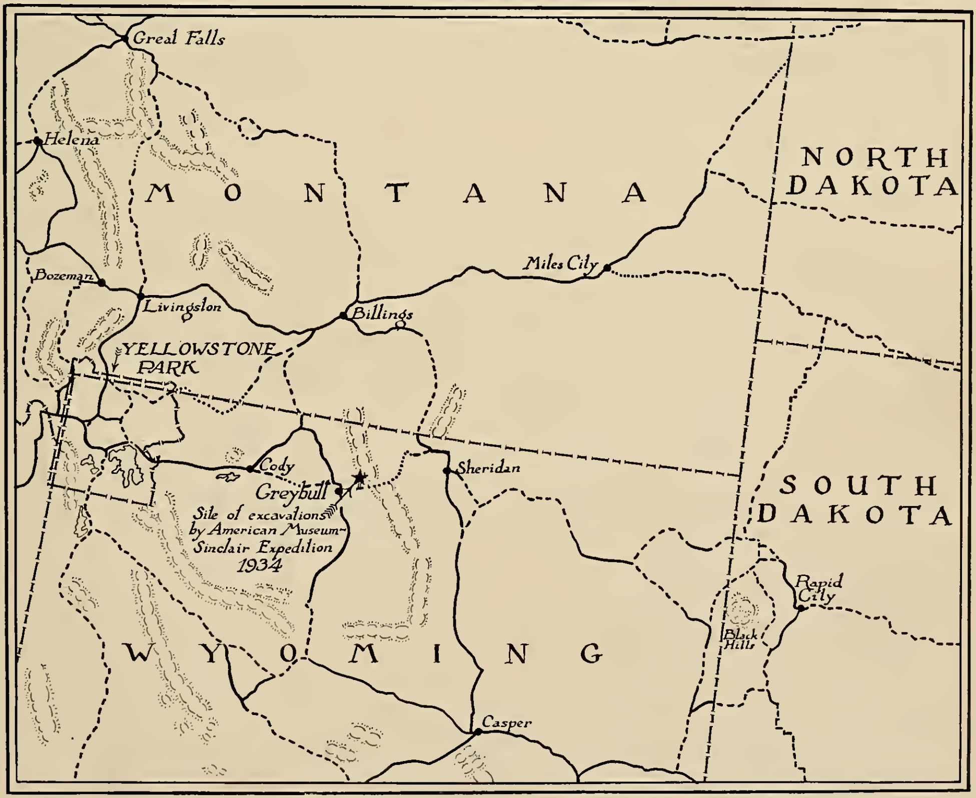
The immense size of the quarry and the confused position of the bones surrounded by clay matrix made it very difficult to preserve them against deterioration by rain, which constantly, day and night, was a cause for worry by the entire party. Unusual clouds or distant thunder were immediate signals for a consultation, and a few rain drops on the tents in the night would send every one scurrying to the quarry — gas lanterns blazing here and there as the large canvas sheets were stretched. We dreaded putting over those covers almost as much as we did the rain, because the whipping canvas was almost sure to dislodge some pieces of bone.

As work progressed, photographs were taken of all phases of the excavation, and when studies had been completed, we began removing the less tangled bones on the border of the deposit. Our difficulties increased as we worked into the masses, for frequently a part of one individual would be removed, while the rest of it was so involved that it would be a month or more later before the rest of the specimen could be plastered. Thanks to our accurate quarry chart, this method could be followed and the entire collection saved.

Four inches of snow fell September 19th, followed by a week of lighter snows, but our work was not long impeded at any time, and on November 17th the last box of fossils was loaded into a car bound for New York and the American Museum.

Evidence of dinosaur habits

In many respects the Howe Dinosaur Quarry is unique. The fossils are of Jurassic age, and here for the first time is evidence connected with the circumstance of their death and burial to indicate with moderate certainty some of the habits of the great Sauropods. This was a mixed assemblage, chiefly amphibious kinds, with the huge long-necked, long-tailed, small-headed Sauropods predominating. In two sections of the quarry the long hind-legged *Camptosaurs* were common. There was no evidence of


Great Falls
Helena
MONTANA
NORTH DAKOTA
Miles City
Bozeman
Livingston
Billings
YELLOWSTONE PARK
Cody
Greybull
Sheridan
Site of excavations by American Museum-Sinclair Expedition 1934
SOUTH DAKOTA
Rapid City
Black Hills
WYOMING
Casper

Where the Sinclair Expedition Operated in 1934

A sectional map of Wyoming and adjacent states. The black star shows the location of the Howe Dinosaur Quarry

Stegosaurs, the armored, long-spined, land-living forms, nor any bones of carnivorous dinosaurs that could be recognized, although a dozen teeth of the carnivorous dinosaurs were found — mostly at the bottom of the bone layer.

Skin millions of years old

Patches of skin impression, in many cases overlaid by the actual substance of the epidermal covering, were found all over the quarry in such profusion that much of it had to be destroyed in preparing the bones for shipment. This is the first recorded instance of such occurrence; it is remarkable that a delicate organic substance of this character could be preserved 140,000,000 years. The skin is being sectioned for comparison with living reptiles.

All skin impression is of the same general character, with low, close-set tubercles, not unlike the skin of the living geckos, with no pattern development as seen in the duck-billed and horned dinosaurs of the late Cretaceous period. In one instance the skin was preserved under a connected Sauropod tail, so that we are reasonably certain that most, if not all, of the skin impressions are from Sauropods.

Most of the described species of Sauropod dinosaurs were found 300 miles and more southward; it is possible, therefore, that this entire assemblage may prove to be a new fauna.

Approximately 4000 bones were excavated in this quarry. They were packed in 144 large cases weighing 69,000 pounds, and filled a large box car almost to the roof.

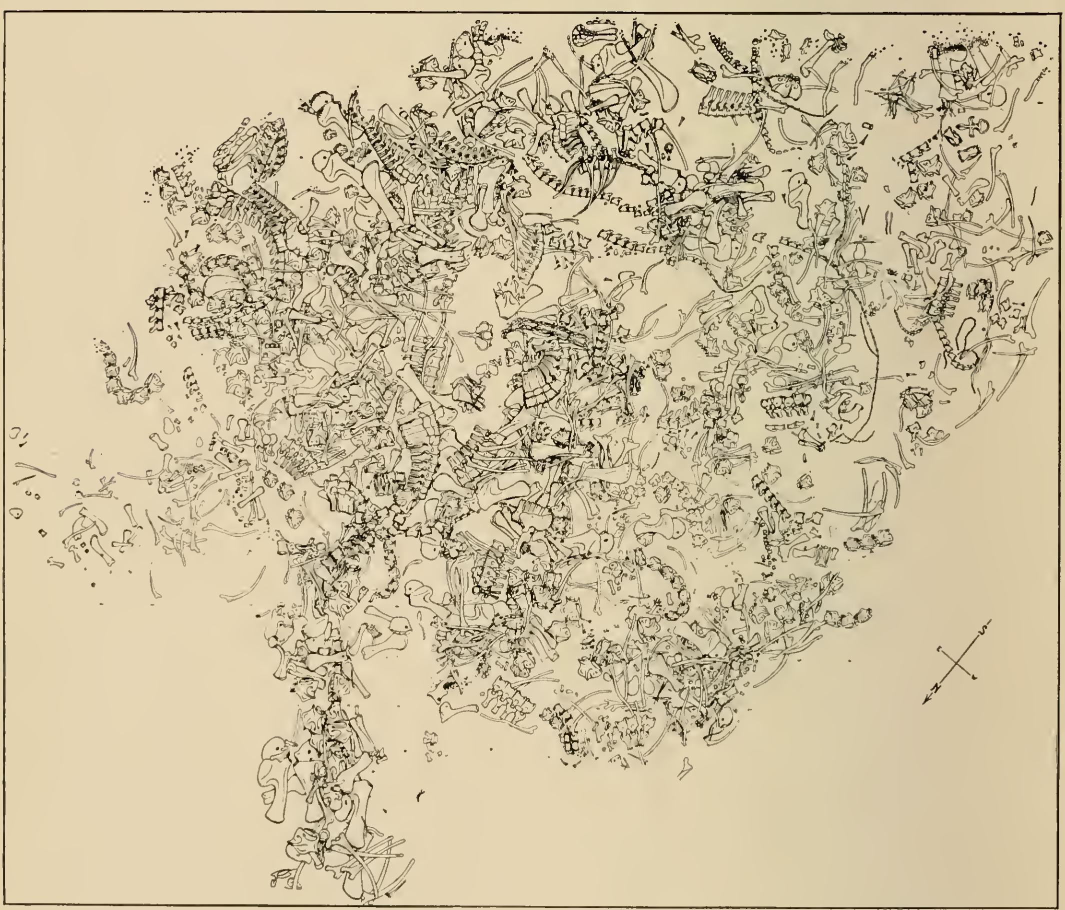
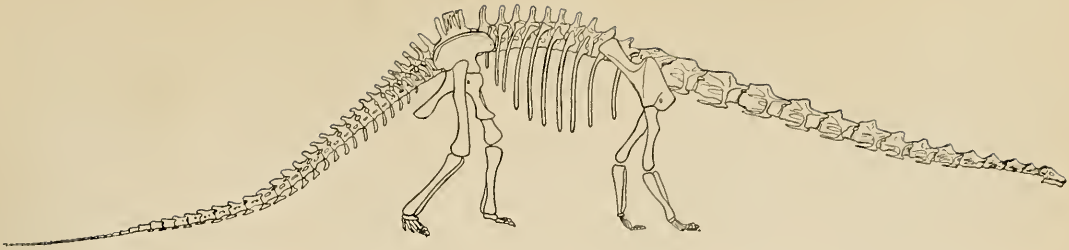


CHART OF THE HOWE DINOSAUR QUARRY

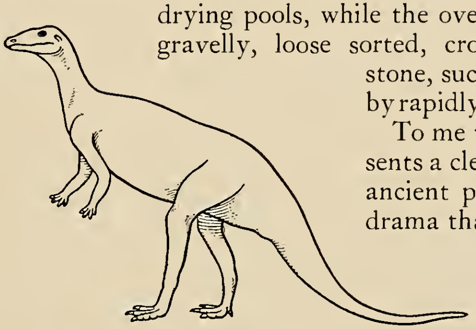
Owing to the confusion of separate bones and sections of bodies, it would be impossible to associate parts of one individual with any degree of certainty without an accurate chart of the bones. This chart was compiled as work progressed, by R. T. Bird, and in importance is second only to the collection of fossil remains. (*Scale: 1 in.=12 ft.*)



Barosaurus SKELETON FROM THE DINOSAUR NATIONAL MONUMENT, JENSEN, UTAH

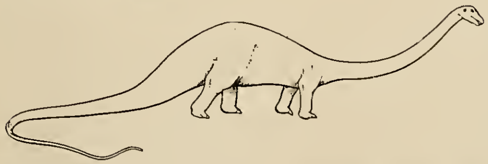
This unique specimen has an interesting history — first a part of the tail was excavated by the Carnegie Museum; several years later the neck was excavated by the U. S. National Museum, and, finally, the body was excavated by the University of Utah. By exchange of specimens the entire skeleton was eventually brought together by the American Museum and is to be mounted in the new Jurassic Dinosaur Hall. This skeleton is 80 feet long. A smaller species half this size was the most common type of dinosaur found in the Howe Quarry

Parts of at least twenty dinosaurs, probably more, are represented by individual bones, and body sections of varying lengths. As clearly shown in the quarry chart, many of these sections belong to the same animal, and we will without doubt be able to mount three slightly composite skeletons representing two distinct Sauropod genera — tentatively identified as *Barosaurus* and *Morosaurus* — the latter a skeleton fifty feet long and the largest in the quarry. The third is a kangaroo-shaped form of medium size identified as *Camptosaurus*. *Barosaurs* and *Morosaurs* predominated. There are several partial skeletons that may prove to be new types when the specimens are prepared and studied.

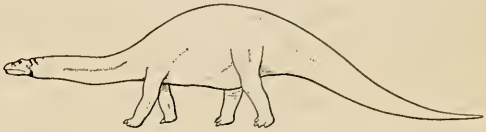


Camptosaurus *is an iguanodont dinosaur having long hind legs and shorter front legs. A large species represented by sufficient material to mount a composite skeleton was found in the Howe Quarry*

The bones had not been drifted or water-worn as are those found in a stream accumulation, and only scattered smaller bones were found on the east and west sides of the quarry, whereas in the center of the deposit the bones were two and three deep; here were found the largest individuals and no less than a dozen limbs standing upright on articulated feet.



Diplodocus *is typical of the long-necked, slender-tailed Sauropod dinosaurs closely related to* Barosaurus. *Several of the whip-lash tails in the Howe Quarry resemble this form*

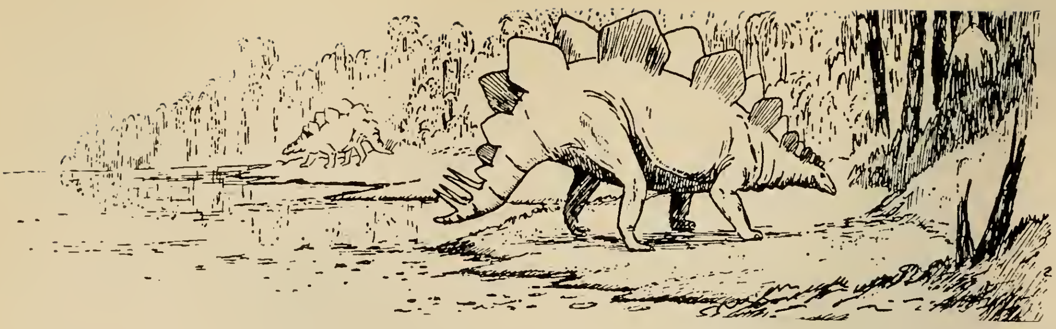


Brontosaurus *is one of the best known of the massive Sauropod dinosaurs; in general it resembles* Morosaurus *the largest animal in the Howe Quarry*

The very fine silt surrounding the bones was such as is found in the bottom of fast-drying pools, while the overlying cover was gravelly, loose sorted, cross-bedded sandstone, such as is deposited by rapidly changing waters. To me the evidence presents a clear picture of the ancient past, a large-scale drama that happened eons ago and one of a half-dozen similar scenes enacted within a short distance of one another in the vicinity. When these creatures were alive, conditions were very different. Here is a cross section of what had been a narrow body of water, pool or lake.

The climate was tropical, and we see a flat land rich in vegetation, dotted by countless shallow lakes and marshes. Cycads, palms, and palmettos cover the lowlands, with pines on the uplands. Countless ferns, thick grass, and rushes form a rank vegetation over the marshy, hummocked shores.

Now the actors come upon the stage: huge slab-sided creatures weighing several tons each, the largest fifty feet or more in



A Plated Dinosaur

Stegosaurus, *the bizarre plated dinosaurs which are so common in the southern part of Wyoming in rocks of the same age were conspicuous by their absence in the Howe Quarry. None of the armored kinds were found*

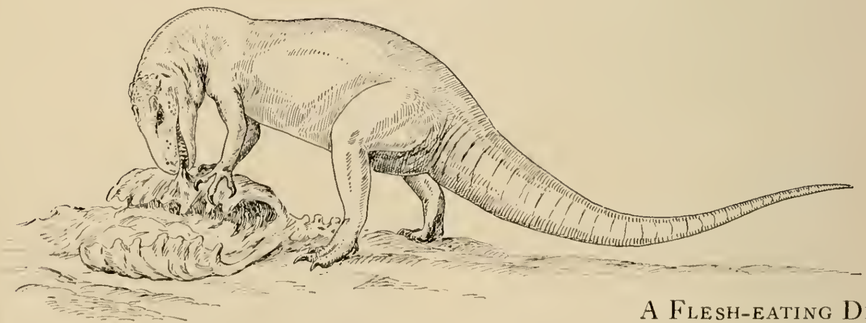
length. They have long whiplike tails and long necks at the end of which is a ridiculously small head. They float, swim, and feed in the water unhurriedly. They congregate by thousands, huddling close together as reptiles do, and filling every lagoon as far as the eye can see.

Now Mother Earth changes the stage setting. The impulse that finally was expressed by the near-by mountains elevated these lowlands. The large lakes were drained and the swamps vanished. The dinosaurs became more and more concentrated in the remaining pools as they were pushed together in huge herds.

The Sauropod dinosaurs were water-living reptiles; consequently, the disappearance of water was their death sentence. Cold-blooded, sluggish creatures of low metabolism, their habits were analogous to the living salamanders. They ate little, hence they were poorly provided with teeth — and a fifty-foot reptile with a nine-inch skull and a one-ounce brain was not adapted for migration. Water was their prime necessity.

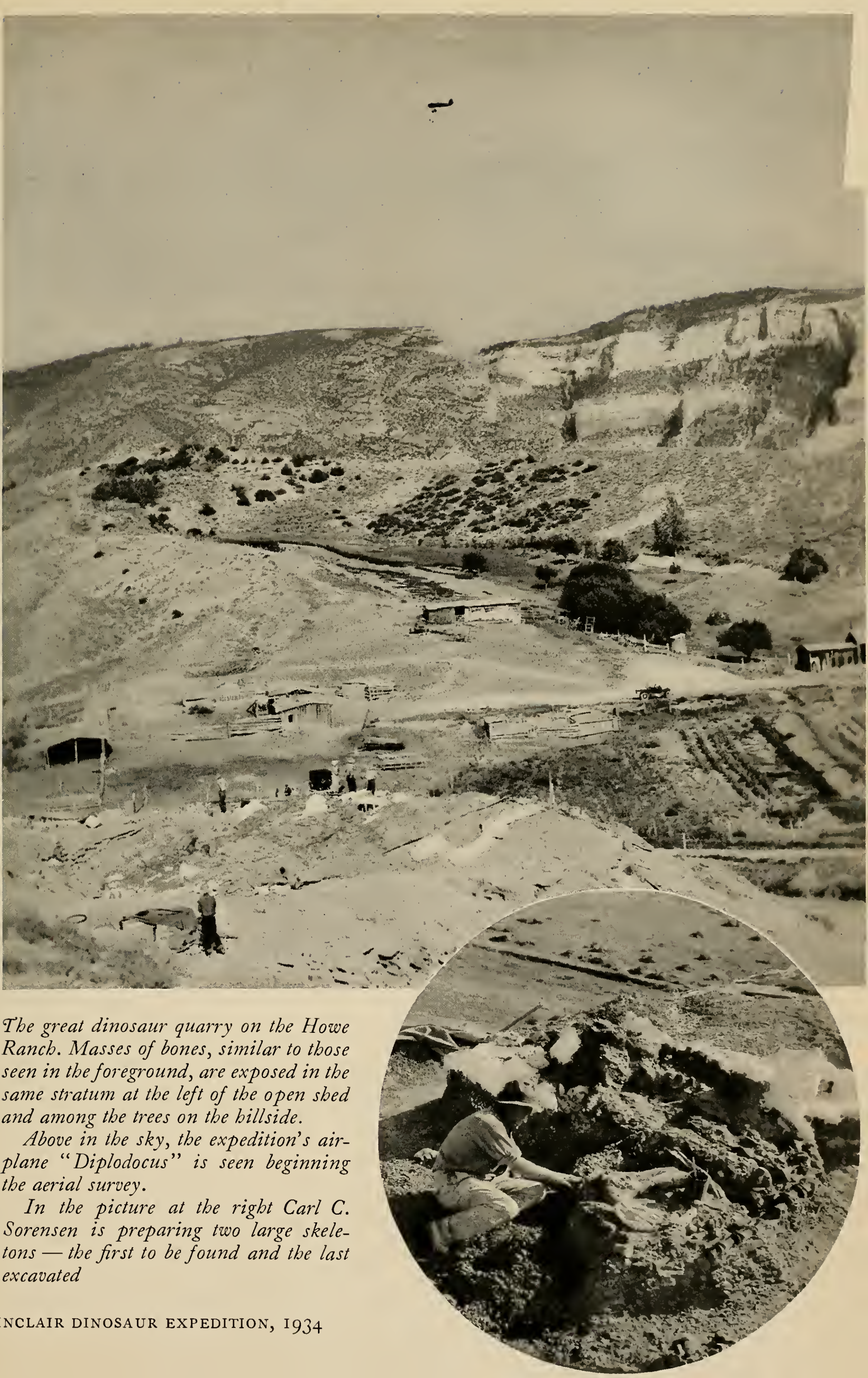
As the water receded, the smaller, weaker dinosaurs were trampled and their bones scattered on the borders of the pool; the large ones huddled closer and closer together as they made their last futile stand against fate. They had come together in a "Last Dinosaur Round-up."

During the summer an extensive aërial survey was made over the Rocky Mountain States, an account of which will be given in a later issue of this magazine.



A Flesh-eating Dinosaur

Allosaurus *is the largest carnivorous dinosaur recorded in Jurassic rocks of southern Wyoming. A dozen teeth representing a similar, but smaller, flesh-eating dinosaur were found in the Howe Quarry*



The great dinosaur quarry on the Howe Ranch. Masses of bones, similar to those seen in the foreground, are exposed in the same stratum at the left of the open shed and among the trees on the hillside.

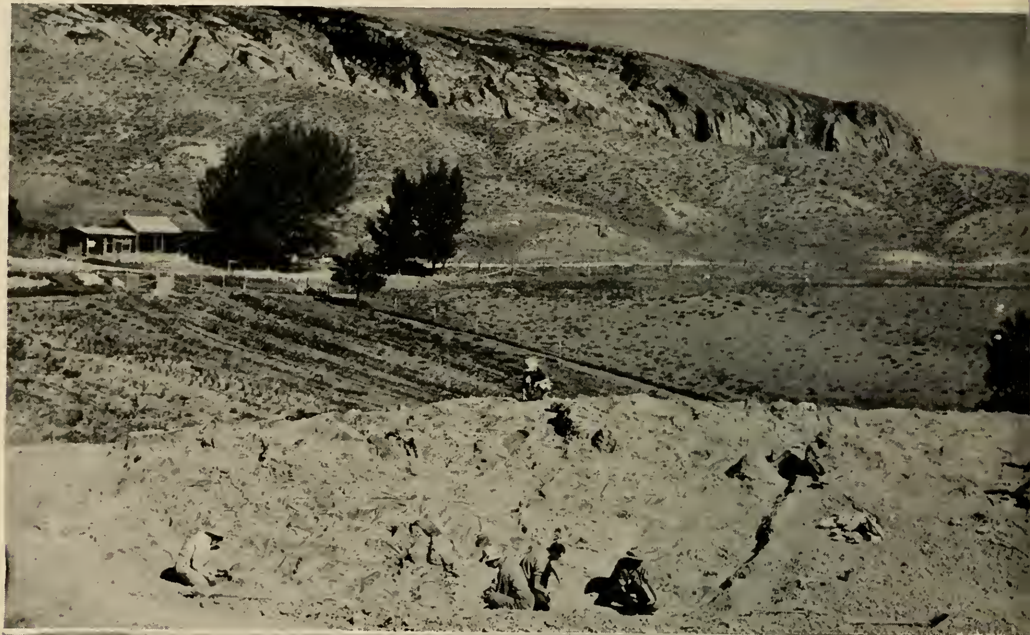
Above in the sky, the expedition's airplane "Diplodocus" is seen beginning the aerial survey.

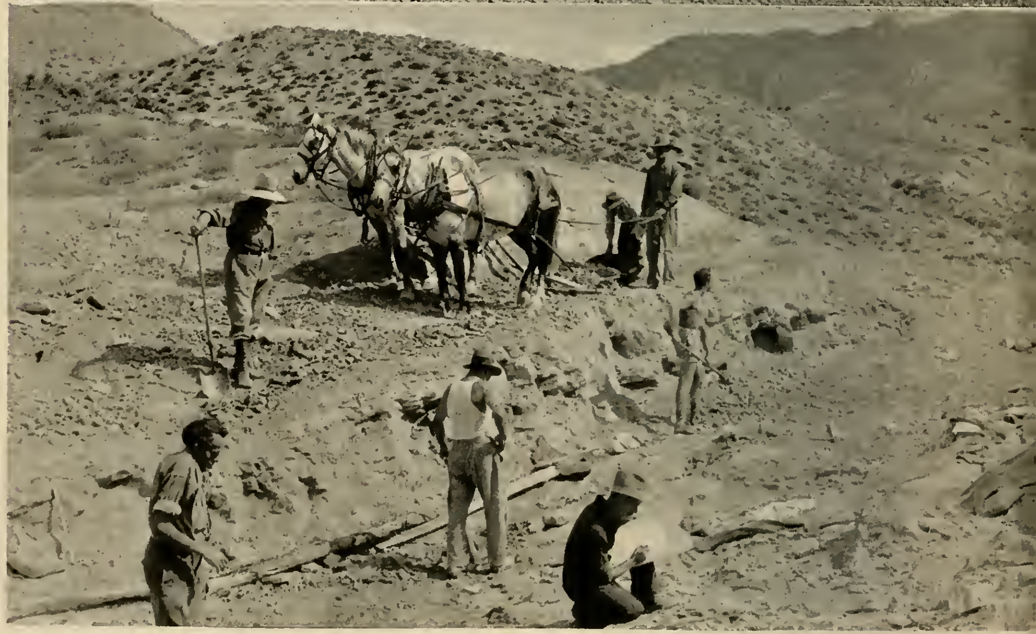
In the picture at the right Carl C. Sorensen is preparing two large skeletons — the first to be found and the last excavated

SINCLAIR DINOSAUR EXPEDITION, 1934

Early Stages of Quarry Preparation

Two months were spent cleaning and hardening the bones before any of them could be removed. At the upper left of the picture the Howe buildings may be seen, and farther in the background are the Big Horn Mountains rolling upward

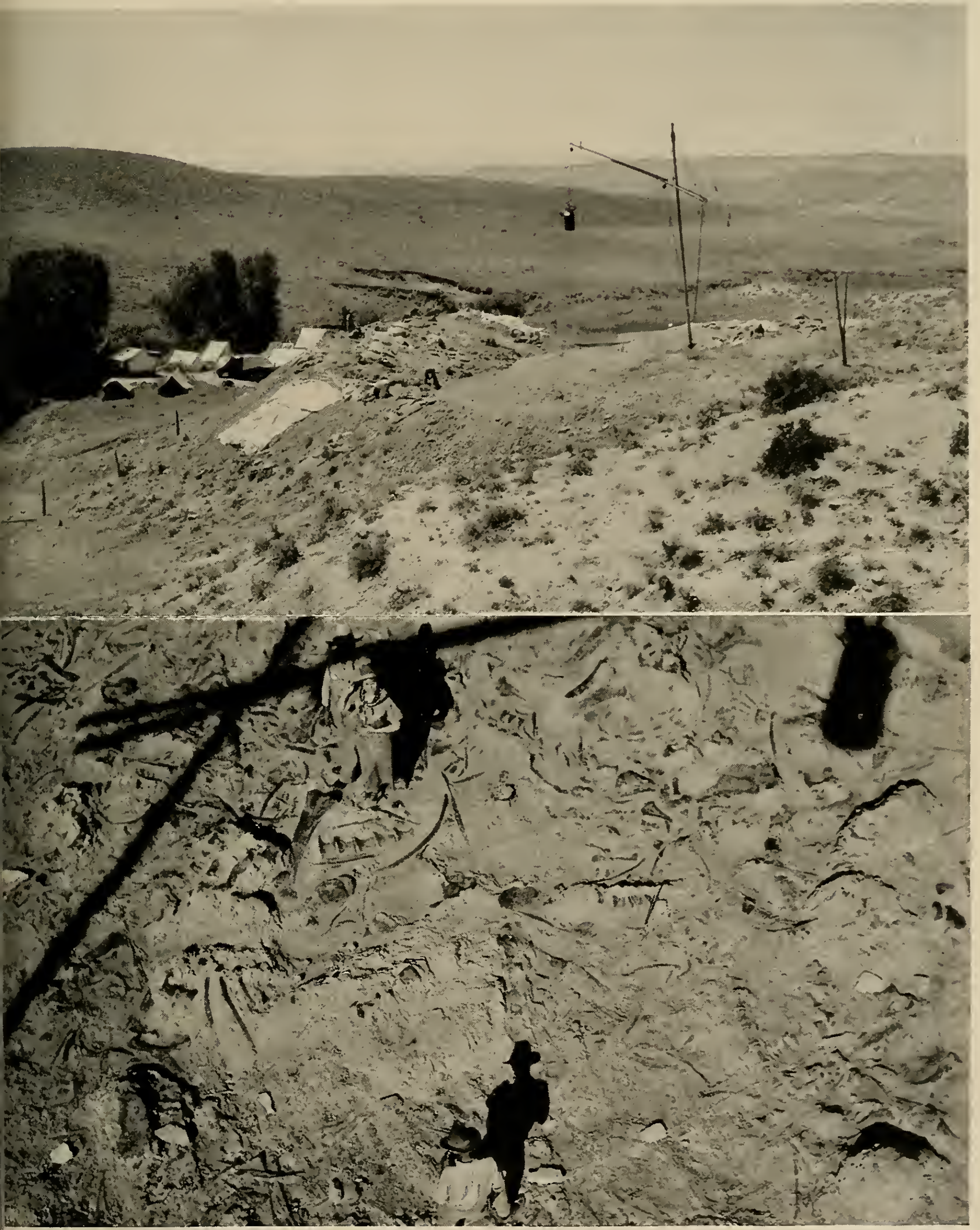




Extending the Quarry on the North

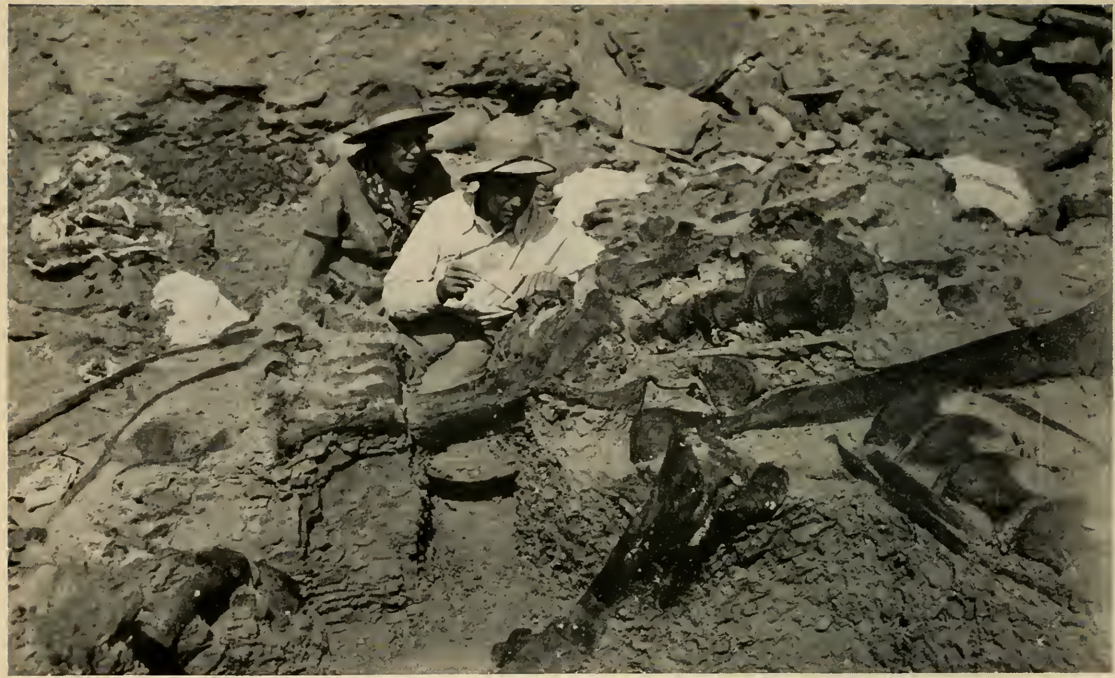
Cross-bedded sandstone six feet thick covered the two-foot clay bone layer, which in turn overlay a continuous hard sandstone. At the lower right are bones in various stages of preparation. Granite peaks of the central mountain core rise in the distance

The eight-degree tilt of the bone stratum is plainly visible in this photograph. From the iron barrel suspended from the hay-stacker the photographer is taking pictures of the bones below. Underlying marine beds are in the middle foreground, and overlying marine beds in the distance



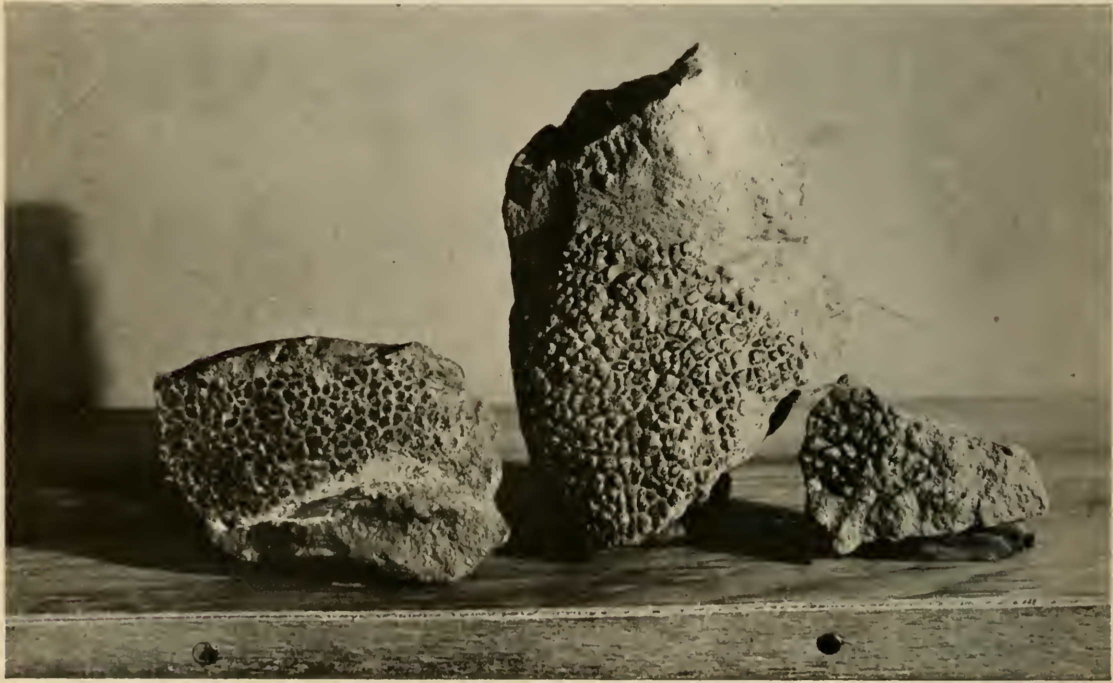
CENTRAL SECTION OF QUARRY WITH BONES PARTLY UNCOVERED

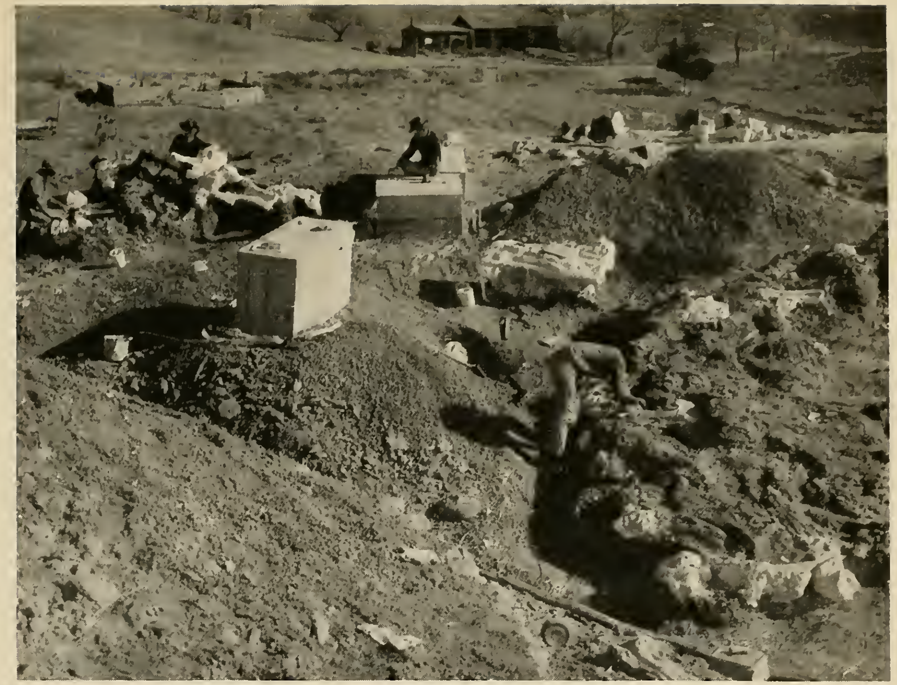
This photograph was taken at right angles to the bone layer, from the suspended barrel, the shadow of which is seen across the quarry. White lines of three-foot squares used in charting the quarry are faintly visible. About one fourth of the quarry is seen in this picture



The central part of the quarry. Doctor and Mrs. Brown are examining the largest skeleton (Morosaurus) *in the quarry; it is approximately 50 feet in length, with a femur 46 inches long and a 26-inch tibia standing on its articulated foot. No less than a dozen such cases were found, conclusive evidence that the bodies were lying where they died*

(Below) Sauropod skin impression, shown about natural size. These three specimens give the range of variation in the form of skin tubercles. The specimen on the left is covered with the preserved outer epidermal tissue. This is the first recorded occurrence of the actual preservation of skin tissue among dinosaurs



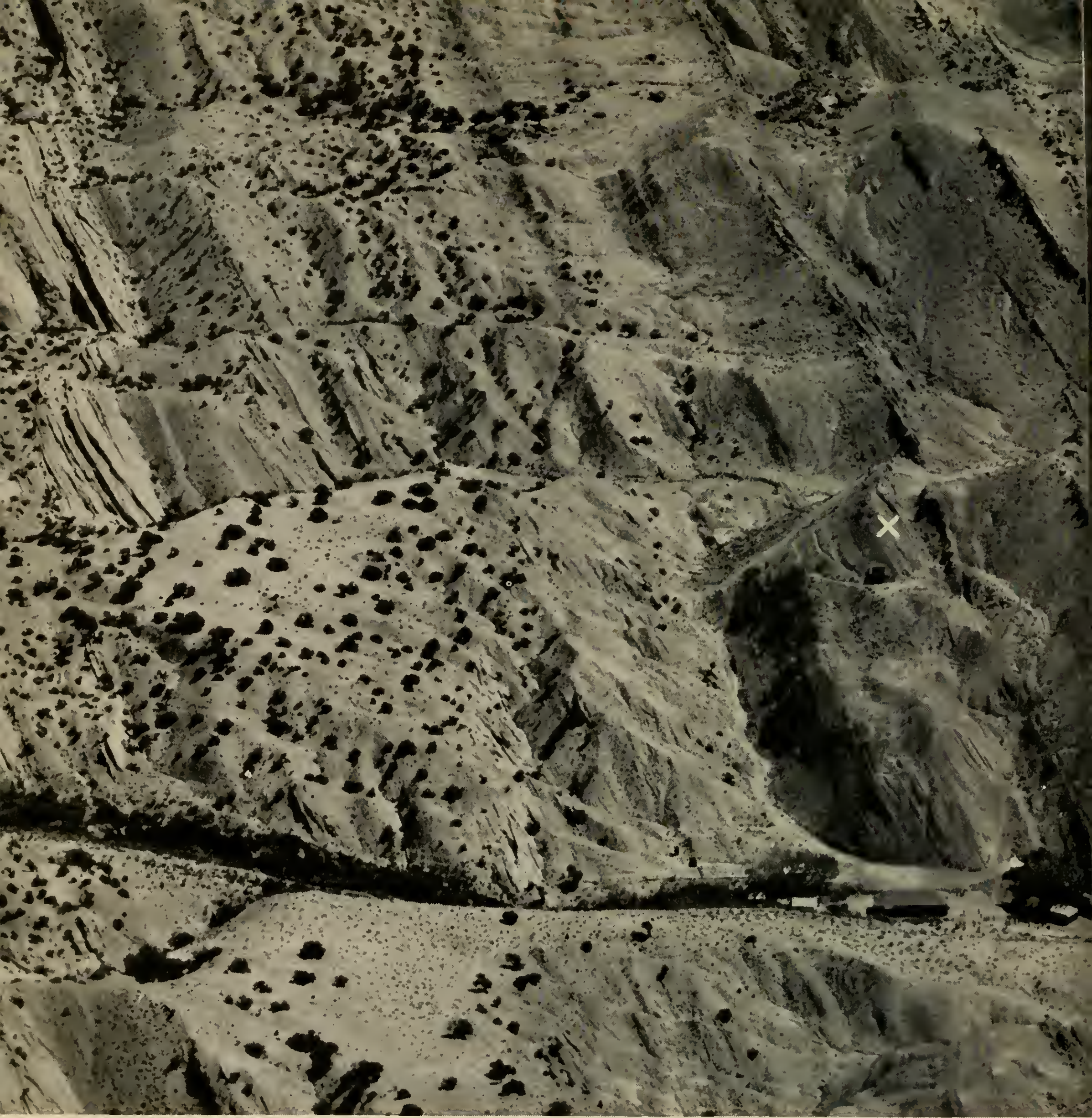


Burlington Route

(Above) The dinosaur quarry during the fifth month of excavation. The central sections had been removed, the more complicated masses at the right and left still remaining

The dinosaurs' last migration. The skeletons had been close together in the quarry, but they were closer in the box car; indeed, it taxed the ingenuity of the party to pack the 144 boxes in one car

Keeping in touch with the world. The party, as composed on August 17th, gathered around the radio at the end of the day. Front row: Roland T. Bird, Dr. Laurence F. Rainsford, Laurence F. Rainsford, Jr., Carl C. Sorensen, Ted Snyder, and Daniel L. Thrapp. Back row, left to right: Mrs. Barnum Brown, Dr. Barnum Brown, William Frutchey, and Milo R. Howe

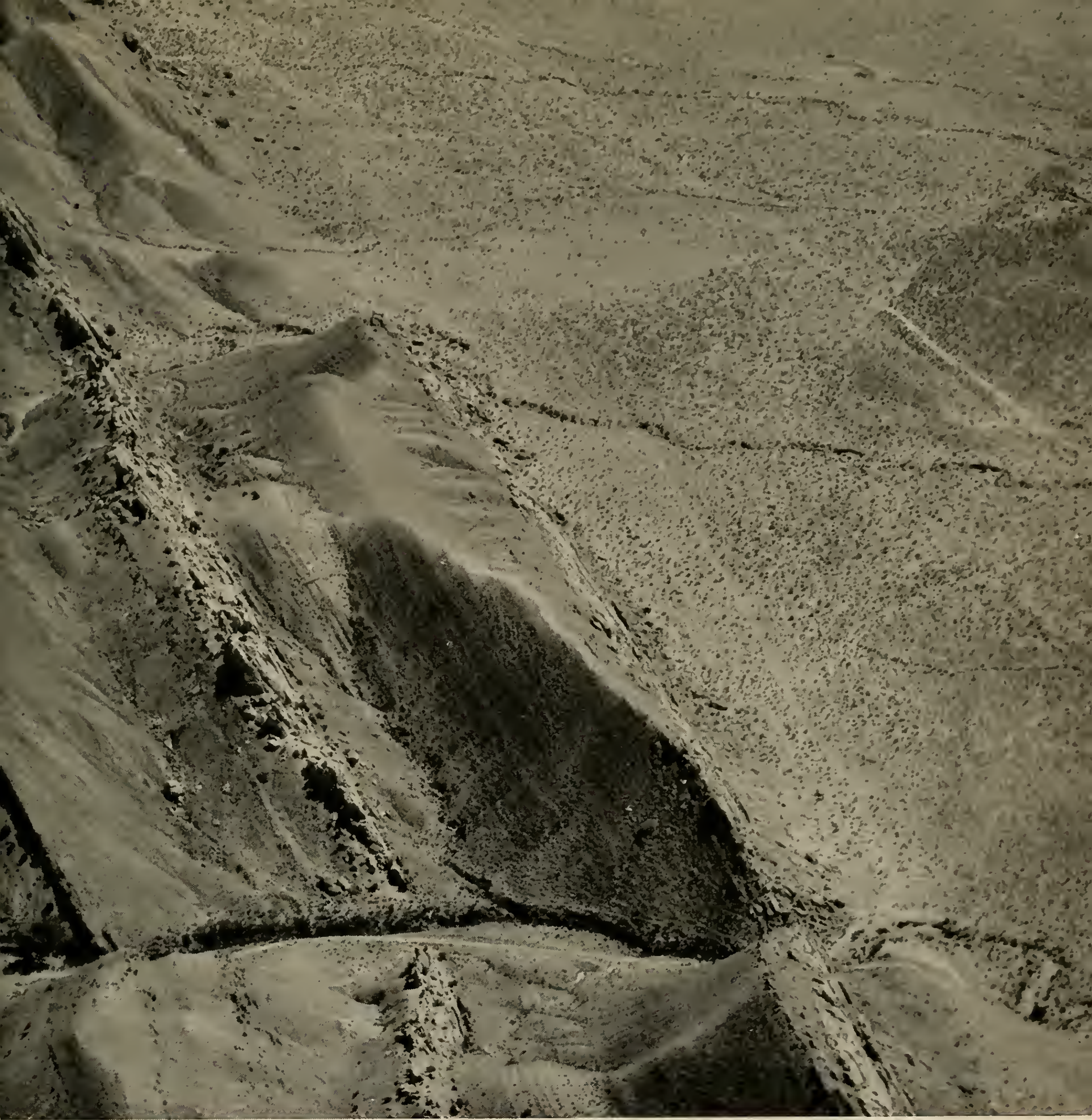


Fifty million years of the earth's history are shown in the above panorama of upturned sediments of Cretaceous, Jurassic, and Triassic age at the Dinosaur National Monument near Jesen, Utah.

The site of the Monument is marked by a white X.

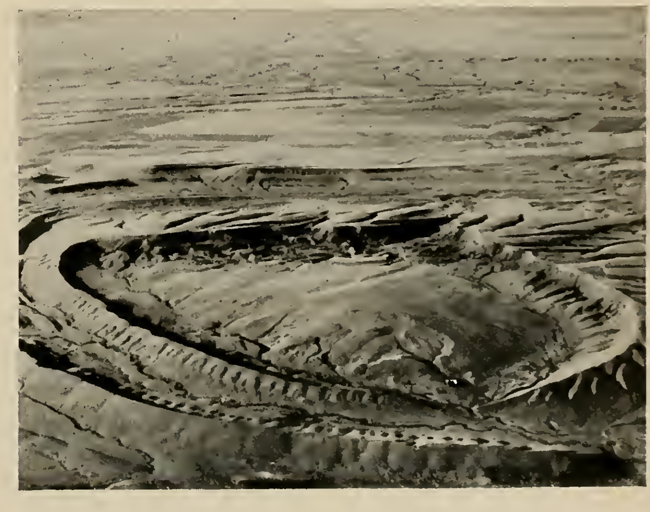
Here is the largest accumulation of dinosaur remains known — now being developed by the National Park Service and the American Museum as a great educational park.

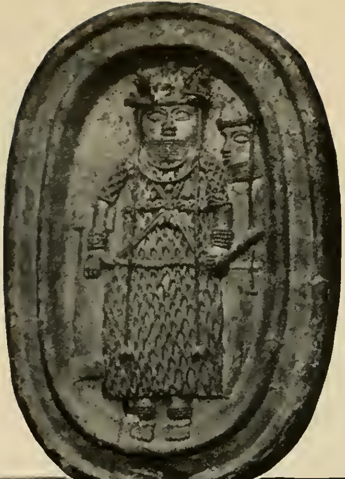
All air views copyright by Barnum Brown



On the left is Meteor Crater, near Winslow, Arizona. The crater is one mile across and 500 feet deep. The meteoric mass that made this crater presumably lies buried under the earth at the right of the picture. Photograph taken from an elevation of 5000 feet

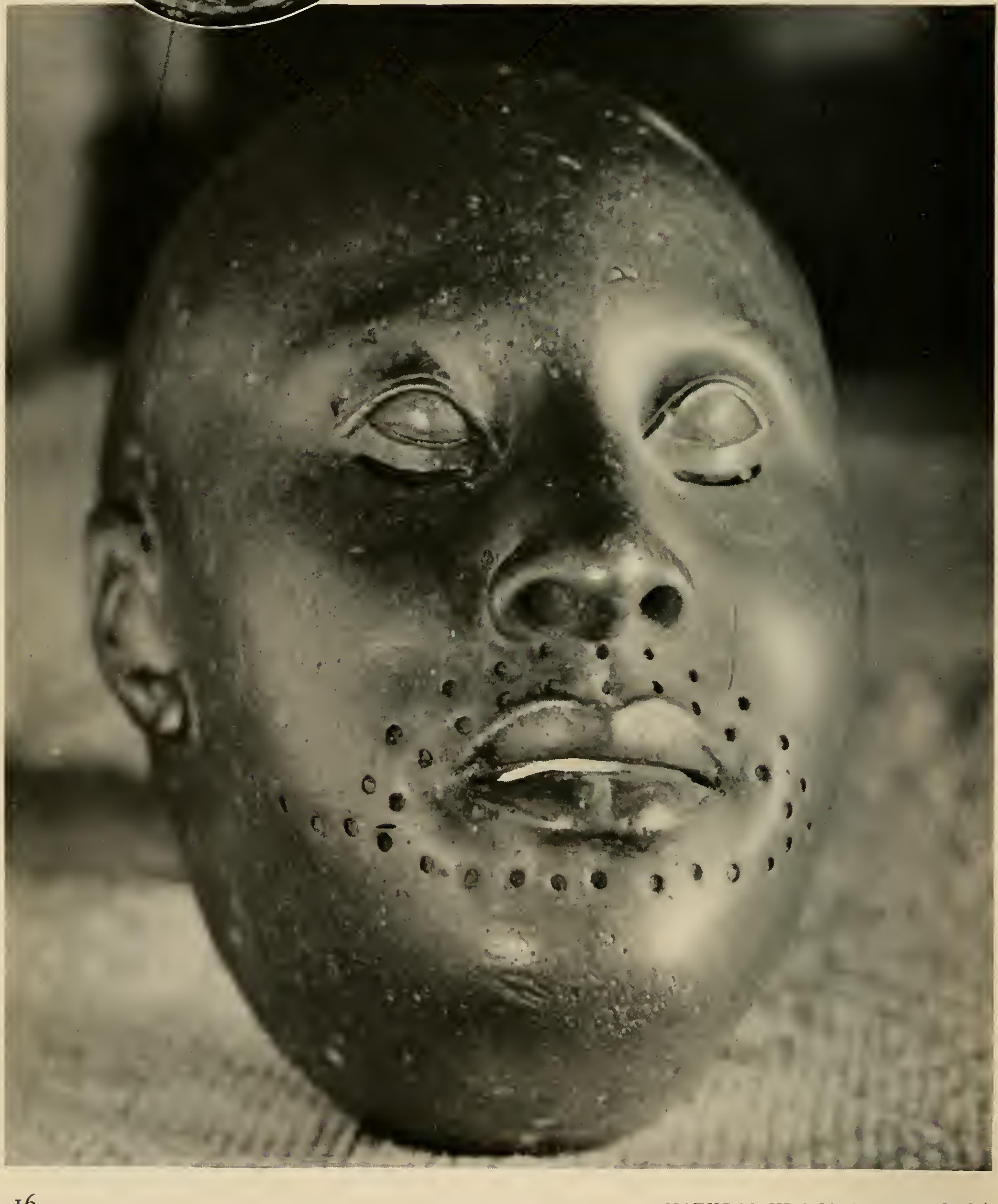
At the right is Middle Dome, 12 miles southeast of Harlowton, Montana. This is a perfect example of structural development demonstrating the theory of oil accumulation





(Left) The King in ceremonial dress with coral decorations. This plaque, of traditional design, was cast in Mrs. Boulton's presence. In the early days metal plates like this one decorated the beams of the Obba's palace in Benin City

(Below) One of the bronze heads representing an early Yoruba ruler who is now an important deity



Bronze Artists of West Africa

The natives of Benin and Ife—their beliefs, customs, and art forms

By Laura C. Boulton

Photographs by John F. Jennings
By courtesy of Field Museum

SINCE the early Portuguese navigators discovered Benin in the Fifteenth Century, the great west African kingdoms of southern Nigeria have furnished the western world with romantic, vivid, sometimes horrifying tales of strange peoples and their weird ceremonies. In the Fifteenth Century Benin was a great metropolis, the capital of the kingdom of the same name and the political and religious center of a wide area.

The Bini people, pushed down from the north by more warlike peoples, found themselves in a region of dense forest where they could not only maintain themselves but were able to extend their influence and power for hundreds of miles east and west.

During the Fifteenth, Sixteenth and Seventeenth centuries, under powerful rulers, the kingdom of Benin was greatly expanded and reached from Lagos to Bonny as well as northward into the savanna country. Regiments of these tribesmen went forth from Benin to conquer new territories. An important general was never expected to return. If he was vanquished, he dared not return. If he was victorious, he preferred to establish himself as the chief of his newly acquired territory and pay tribute to the Obba of Benin rather than return to his service.

The people of Benin

It is thought that the Bini are an offshoot of the Yoruba nation. Though their language differs somewhat from the Yoruba, their customs, traditions, religious practices, and beliefs definitely link them together ethnologically.

According to the accounts of early European navigators, the King of Benin, although a mighty ruler of a great kingdom, received his investiture from another powerful monarch who lived "toward the east" and who sent each new king of Benin a staff, a cross, and a cap of shining brass. Heads of bronze were also sent as gifts to these new kings. It is believed that this mysterious potentate was the Awni of Ife, the spiritual ruler of the great Yoruba nation.

Ife, the sacred city, boasts a long and glorious past. The Yorubas have a tradition that their ancestors came from Egypt and settled there, and their nation increased and spread until it now numbers more than three million people and covers a huge area in southern Nigeria.

The father of all the Yorubas

Native tradition tells that through the centuries there always have been a war-king and a priest-king ruling equally. The first king was Oduduwa, a mythical personage, a great leader who brought his people safely through the northern desert to Nigeria. He died at Ife and later was deified and identified with the Earth Goddess. His grandson, Awranyan, who succeeded him on the throne, is regarded as the father of all the Yorubas existing today.

Awranyan moved the capital to Oyo, a city near Ife, and left a henchman in charge of the treasure of Ife. This man, as the High Priest, became very powerful and received the title "Awni of Ife." His descendants still hold sway over the religious life of the Yorubas and are the rulers of the spiritual affairs of the natives, while the temporal head rules from Oyo.

Awranyan, who was a powerful and warlike ruler, extended his kingdom in every direction. After a long period he found it necessary to return to Ife from Oyo to examine his father's treasures. His stay in Ife was so prolonged that in Oyo his people thought he must have died and they proclaimed his son king. Later, Awranyan started back to Oyo, and while he was still some distance from the city, he heard the kakiki trumpet which is never blown except for the king. When he learned that his son was king, instead of entering Oyo, he quietly returned to Ife, where he lived peacefully.

Awranyan's staff

Near one of the sacred groves where religious rites are performed is a granite obelisk about twelve feet high and four feet square at the base, which is known as the *Opa Awranyan*, or Awranyan's staff. To prove what a mighty man he was, the Yoruba say that he carried it about with him as a walking stick.

This obelisk is erected on the spot where he is supposedly buried. At present there is evidence that a storm blew it over and damaged it considerably. A section four feet in length was broken off the top but has been replaced. Several fragments lying about the base indicate that perhaps it was once much taller, or that there was another obelisk of less imposing proportions.

On one of its faces there are three rows of nails with coiled heads. In the center from the bottom reaching nearly to the top is a row of 61 nails. About four inches on each side of this are two parallel rows of 31 nails each. A few hieroglyphs can be seen where the lines converge.

One explanation is that the 61 nails represent the years Awranyan lived, 31 nails on one side indicate that he was 31 when he came to the throne, and the second row of 31 indicates that he ruled 31 years, counting the first year of his reign twice according to Yoruba custom. The ancient hieroglyphs may stand for Awranyan.

The art of carving or drilling in stone such as is used on the obelisk has long since been lost. The Yorubas believe that the staff was once wood and the nails were driven into it then. It was turned to stone when the ruler Awranyan was deified. In the grove near by are the sacred trees, *Dracæna*, called *peregun* in Yoruba. It has been suggested that these trees have a symbolic meaning and are planted in the sacred groves because of the similarity of their exudation to the blood of human beings.

In the sacred groves near Ife have been found remarkable sculptured heads and figures in terra cotta and bronze. The Yoruba explanation of these antiquities is that the ancient rulers were deified and at the same time petrified. They believe the bodies have in most cases disappeared, but the heads remain to receive adoration and offerings. When Frobenius, the German scientist, discovered some of these in 1910, he believed he had found the descendants of the lost Atlantans. Since then many theories have been advanced regarding these works of art. The natives regard them with the highest respect as sacred objects. Many of these sacred heads have now been brought from the groves into the Awni's palace, where they are kept in chests carefully protected from the elements and marauders.

An audience with the high priest

I was eager to study the art which had made this sacred city famous throughout the world and to record the music of the court musicians of the Awni. Every effort was made to observe the necessary native etiquette in order that nothing might mar the success of the plans. The Awni received me in the throne room where great chairs were provided beside his throne. He had sent for his priests who came from the outlying regions to salute their High Priest. The salutation ceremony was indeed impressive as they prostrated themselves before the throne, first the greater priests, then the lesser priests, chanting a prayer for the long life and prosperity of the Awni. He responded briefly to each phrase of the chant.

Although the Awni understands English perfectly, all "official" conversation was carried on through an interpreter. Through this interpreter our English escort spoke at great length, telling the Awni what fine people we were, how many thousands of miles we had come to visit him, and ended by informing him that we buy large quantities of his cocoa in America where we live. As that is their chief produce for export, this remark drew smiles of appreciation from the assembled chiefs.

The Awni, in a very quiet and dignified manner, made a long impressive speech in Yoruba, which the interpreter translated as a glowing speech of welcome. It was then my turn. With sincere truthfulness I told him how happy we were to be there, how very much interested we were in the customs of his people, especially in their music and art, and how eager our own people in America would be to hear about it.

Every courtesy was shown us as long as we stayed in Ife. To show his hospitality, the Awni offered us large gourds of kola nuts—bonbons to the natives but bitter as gall to us. He had the chests of ancient treasures brought out, and we were permitted to photograph the sacred heads, the sacred carved doors, to make measurements of these objects, and to go wherever we wished in the palace and the sacred groves. He called his court musicians to perform for me their ceremonial music. And as a final tribute, when we said farewell and were leaving his palace, the royal trumpet which is ordinarily blown only for the king was sounded. When I saw this great trumpet (so long that an assistant had to support the outer end while the musician blew it) and heard the terrific blast which seemed to make the whole world quake, I had a vague conception of the emotions which must have swept over Awranyan, the ancient ruler, when he turned back to Ife as his final home and resting place.

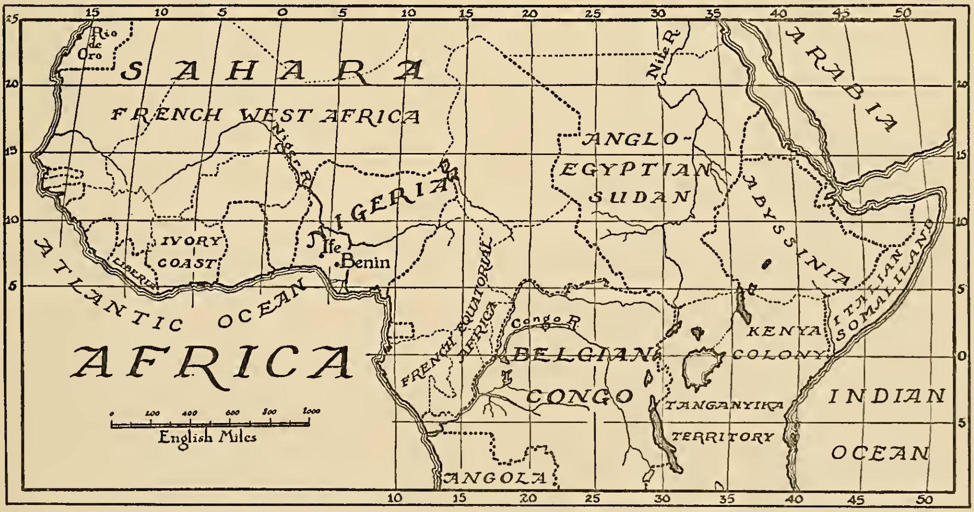
Modern travel between ancient cities

Formerly it must have taken many days for the Awni's messengers to travel on foot through the treacherous forest to reach Benin with gifts of brass and bronze for the newly inaugurated Obba. The present hard-surfaced road follows the path of the early travelers, but with modern motor cars and excellent highways the distance between these historic cities can now be covered in one good day's drive.

The "City of Blood"

Benin, situated more than fifty miles from the coast, has long been famous as the "city of blood." It is said that a Catholic mission was established here in 1485, but the prosperity of the mission was short-lived. In return for "the small consideration of a Portuguese wife" the Obba promised to drive all his subjects into the bosom of the church, and the missionary settlement soon had 1000 members. However, the climate was extremely unhealthy for Europeans and the natives were not sufficiently enthusiastic about Christianity, so missionary efforts were abandoned.

The Obba of Benin continued to be friendly with the Europeans and trade prospered through the Sixteenth and Seventeenth centuries. European traders were not often encouraged to visit Benin itself, and human sacrificial rites were rarely wit-


SAHARA
Rio de Oro
FRENCH WEST AFRICA
NIGER R.
NIGERIA
IVORY COAST
LIBERIA
Ife
Benin
ATLANTIC OCEAN
AFRICA
0 200 400 600 800 1000
English Miles
FRENCH EQUATORIAL AFRICA
Congo R.
BELGIAN CONGO
ANGOLA
ANGLO-EGYPTIAN SUDAN
NILE R.
ARABIA
ABYSSINIA
ITALIAN SOMALILAND
KENYA COLONY
TANGANYIKA TERRITORY
INDIAN OCEAN

THE WEST AFRICAN KINGDOM OF SOUTHERN NIGERIA

During the Fifteenth, Sixteenth, and Seventeenth centuries, the kingdom of Benin was greatly expanded along the coast and northwest into the savanna country. Benin City is the political and religious center of the Bini, while the sacred city of Ife is the dwelling place of the spiritual ruler of the Yoruba nation nessed by outsiders. But the early Portuguese, Dutch, and Swedish navigators brought back to Europe rumors of a mighty kingdom with a capital city five miles in girth surrounded by a moat and a great wall ten feet high.

It was said that the King's palace was very spacious and filled with magnificent carvings in ivory and wood and castings in brass and bronze. A report brought to the western world in 1825 stated that much of the ancient splendor had disappeared. By 1892, when Captain Gallwey visited Benin, the town was greatly reduced in wealth and in size. Occasional civil wars had ravaged the city, and with remunerative slave raids ended and all trade relations with Europeans forbidden by the King, much of the former greatness disappeared.

A fateful expedition

In 1896 an English expedition left the coast, carrying gifts and merchandise to Benin. Neighboring chiefs urged them not to approach the city at that time. Overami, the Obba, warned them not to come, as the Bini tribe was celebrating the great feast for the anniversary of the death of Adolo, Overami's father. Courageously but very unwisely the small group of Englishmen proceeded unarmed toward Benin and walked directly into an ambuscade prepared for them. All were massacred except two. These escaped and after terrific hardship reached the English settlement at the coast to tell the tale.

Within five weeks (January, 1897), a powerful expedition retaliated, advanced on Benin, and after fierce fighting, took the city. The Obba fled to the dense forest but finally tired of bush life, surrendered, and was brought back with certain of his chiefs to be tried for the massacre of the white men. Seven chiefs were sentenced to death (for the seven white chiefs who were killed so mercilessly). The Obba, whose innocence in planning the massacre was established by all the witnesses, was exiled to Calabar. As he was a great juju man, it was necessary to send him far from his province in order to break down his influence with the Bini people.

Of all the riches that had formerly been his to command nothing was left. His lands were taken over by new rulers. His eighty wives and his concubines were sent back to their families with the exception of two — his favorite wives — whom he begged to take with him into exile.

The taking of Benin City

Due to the sacrificial rites which were being observed, the English expedition found Benin in a terrible state of bloodshed and disorder that made its name "the city of blood" seem very appropriate. Yet the Obba was not regarded by his subjects as a cruel or bloodthirsty man. He was simply carrying out the tribal traditions which had been handed down through a score of dynasties from the reign of the first Obba, a son of the great Yoruba ruler, Awranyan of Ife.

The taking of Benin City revealed not only the horrors attendant on the practice of human sacrifice, but it led to the discovery of art treasures exceeding all expectations. Travelers in west Africa had reported seeing in the King's compound and in the juju houses remarkable works of art in bronze, brass, and ivory. But no traveler or ethnologist dreamed of the vast quantity and the amazing variety of objects hidden there.

Every house had its altar, and sometimes these bronze objects were buried in the altar itself or in the surrounding walls. In these unexpected spots bronze jugs, vases, staff heads, and figures were found. Plaques with intricate designs decorated the beams of the Obba's palace. The most spectacular works were on the juju altar in the King's compound. Early descriptions of these altars indicate that the same sort of objects decorated the altar then as at present.

Bronze casting

Most of the ancient works were removed to European museums soon after the capture of Benin, but the artisans continued to fashion these castings in bronze after the same style and method. Now the altars are again filled with the traditional ceremonial objects. Some have been made since the capture of the city; some had doubtless been hidden in the forest and have been brought forth from their hiding places. Large carved ivory tusks are supported by life-sized bronze heads. There are smaller bronze heads and figures of equal excellence and brass bells remarkably well executed. Metal swords and staves of wood carved to resemble bamboo which served both as rattles and as clubs are also used on the altars.

These bronze castings are made by the "cire perdue" process. A core of special clay is formed on which the figure is modeled in beeswax. The very fine details in wax, such as the beads of the headdress and necklace, are attached to the model by means of a heated wire which serves as a soldering iron.

Preparing the mold

The wax model is carefully coated with fine clay and eventually completely covered with a heavy mass of clay in which an outlet is made for the wax to escape when melted. The mold is then baked in charcoal embers. A mold of exactly the design of the original wax model remains after the wax has melted.

The molten bronze fills every hollow left by the wax. After the metal has cooled, the clay mold is broken away. Obviously only one casting can be made from the wax, and this accounts for the fact that no two works are identical. Incidentally this complicated method used with success and familiarity by the Benin "savages" is the same process as that used in Italy during the Renaissance. By no other conceivable method could such elaborate detail and such extravagant relief be obtained as is found in the plaques or tablets representing the victories of the Bini over their enemies.

A series of about three hundred of these panels is now in the British Museum. The masterful way in which the detail is treated and the composition indicate that these highly developed castings were produced by a people long familiar with the art of working metals. The plaques show only one phase of the bronze casting of Benin. These artists are equally successful with objects in full relief, such as heads, bells, vases, and other things of minor importance.

The question is invariably raised as to where the people of southern Nigeria learned the art of metal working. Both in Ife and Benin are found remarkable bronze castings which are absolutely unique; there is nothing like them in any other part of the world. The *method* of casting may or may not be indigenous; in a short article that discussion cannot be adequately dealt with. The *style* is definitely African; the Benin productions represent a form of real native art with stylistic features which are fundamentally negroid.

As we entered Great Benin last August, it was impossible not to recall the tales of her past glory and horror. All is changed now. Instead of traveling on foot through almost impenetrable forests and swamp-lands, one motors on a good highway. The town is peaceful, quiet, and orderly, under the present Obba who rules in friendly coöperation with the British government. Even though we had been informed that the Obba was a well-educated, intelligent young man, we were a little surprised to find him seated in a beautifully carved chair with a volume of Chesterfield's *Letters to His Son* in his hand.

In order to have a ready-made topic of conversation for the occasion, I had recorded a few Bini songs to take with me. These I played for the Obba and he found them most interesting. But he said, "My court musicians could perform these songs very much better. Would you not like to have them sing for you?" Of course, that was exactly what I wanted more than anything else in the world. So the matter was quickly arranged.

Court splendor

At the appointed time I arrived with my recording apparatus at the royal palace and was ushered into a huge hall to await His Majesty. Soon I heard great excitement outside. The Obba in his ceremonial robes was emerging from his private quarters in the palace, attended by his entire retinue. His headdress was a magnificent creation of coral woven in such a fashion that the hair and head were entirely covered, allowing only the face to be seen. His necklaces, bracelets, and sandals were of coral. No one knows exactly at what remote date coral came to represent royalty among the Bini people nor where that coral came from. The flowing garments of the Obba were of brilliant brocades.

The Obba's entourage

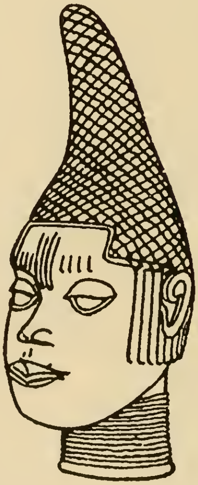
Among the followers of the Obba were, first in importance, the chiefs who make up his advisory board and who have considerable authority. There were about fifty of these, bare to the waist, with necklaces of coral and long loin cloths drawn about the hips and knotted at the waist. Two groups of musicians accompanied the Obba; one playing flutes preceded him, the other playing horns and gigantic gourd rattles brought up the rear. The sign of office was a huge executioner's knife with wrought iron blade and wondrously carved handle. This knife shadowed the Obba constantly; if he advanced a step, the knife advanced; if he retreated, the knife did likewise. Two young boys were continually at the Obba's side, literally as his arm-bearers. They supported his arms at the wrist and elbow while he walked. When he paused, he rested what seemed to be his whole weight on one of the boys by leaning his arms on the boy's head.

After a ceremonious greeting, we progressed slowly amidst a cheering throng of several hundred of the Obba's devoted subjects to the court, where we entered through the east gate according to custom. It was here that the ancient sacrificial rites in honor of the spirits of the dead kings were performed. The memorial mounds erected for the previous Obbas were piled high with carved ivory tusks, heads and figures in bronze and brass representing the former kings always shown in ceremonial robes. Brass bells with unbelievably sweet tones were used to call the spirits to come and accept the sacrifice.

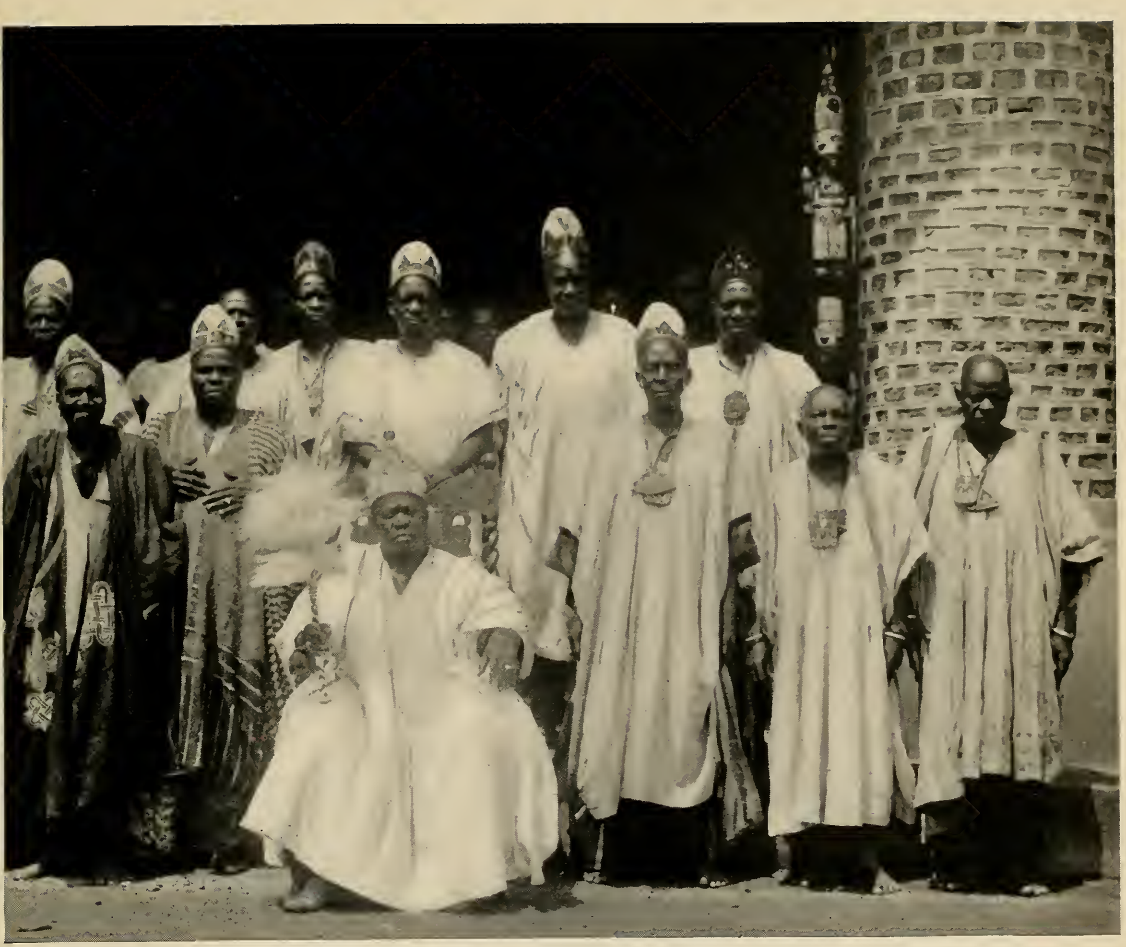
The musicians, as well as the Obba and chiefs, wore ceremonial dress, because the songs of the ceremony to the dead kings cannot be sung without it. This rite is performed only once a year. In the old days it lasted three months and was a great orgy of human sacrifice. Now it lasts only twenty-four hours, for the sacrifice now consists of domestic animals which are expensive. I recorded the entire cycle of songs for this ceremony, the songs for the greater chiefs, for the lesser chiefs, for the Obba's wives, while they all in turn performed their part of the ceremony, and so on until the Obba's song which ended the dancing and was the signal for the priests to proceed with the sacrifice.

New means of art expression

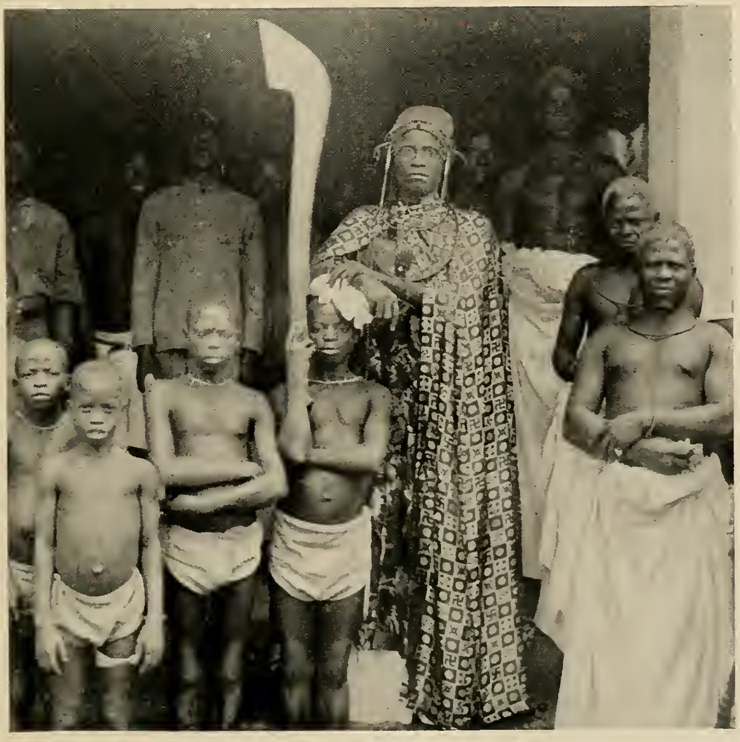
In the art treasures of Benin and Ife one is impressed by the grave simplicity, the beautiful proportions, the strength, vigor, and boldness of the modeling, and the feeling for design which is always evident. A study of the music of this region also furnishes additional evidence of the genuine, innate artistic sense of the African negro. In his art forms he has preserved for posterity the traditions and inspiration of his ancestors, and through the influence of these artistic forms modern artists and composers of the western world are finding new means of expression.



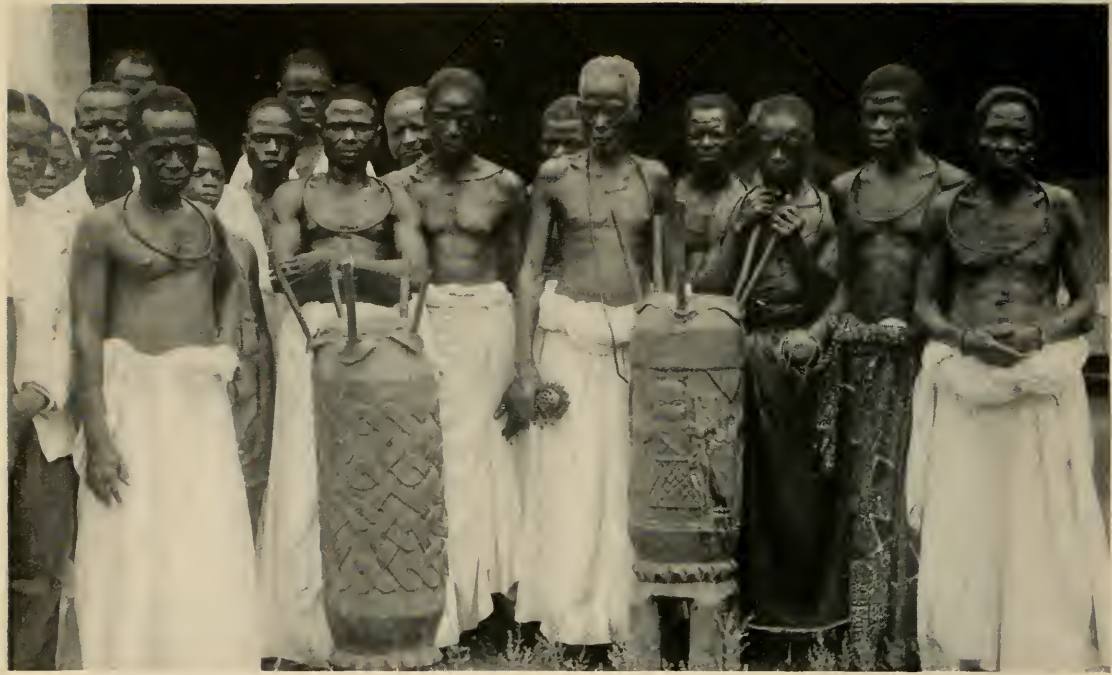
Sketch of a Benin bronze



(Above) The Awni of Ife, spiritual ruler of the Yoruba people, surrounded by his high priests

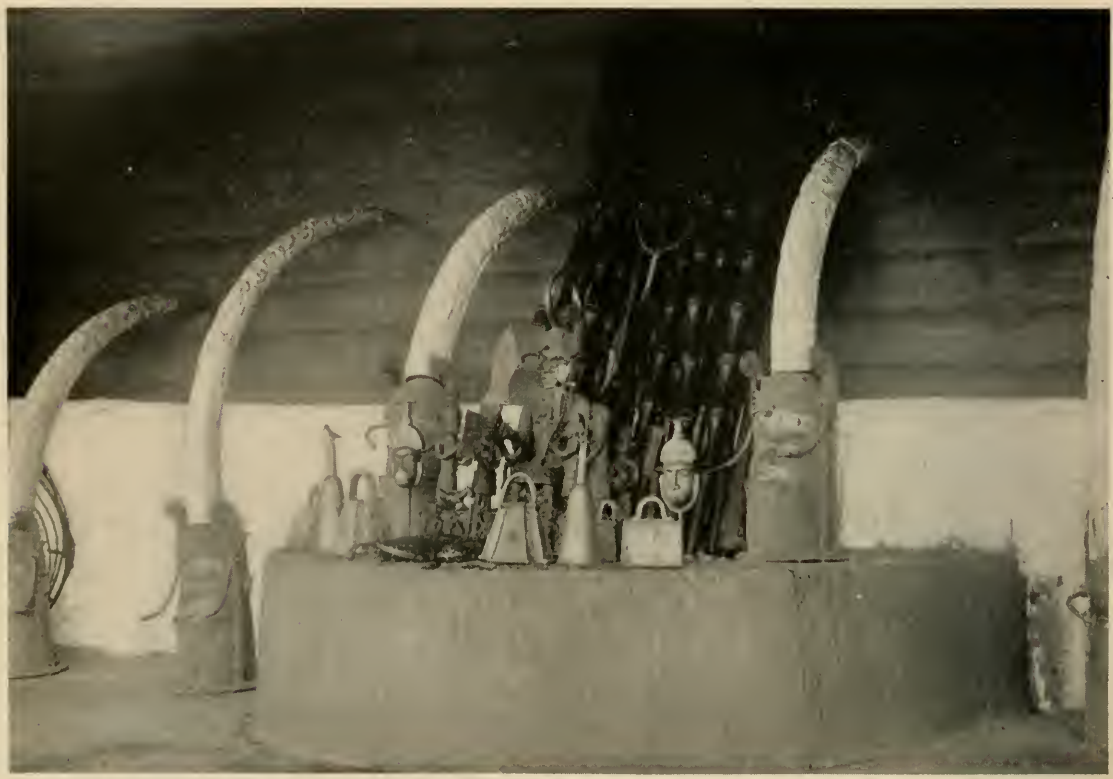


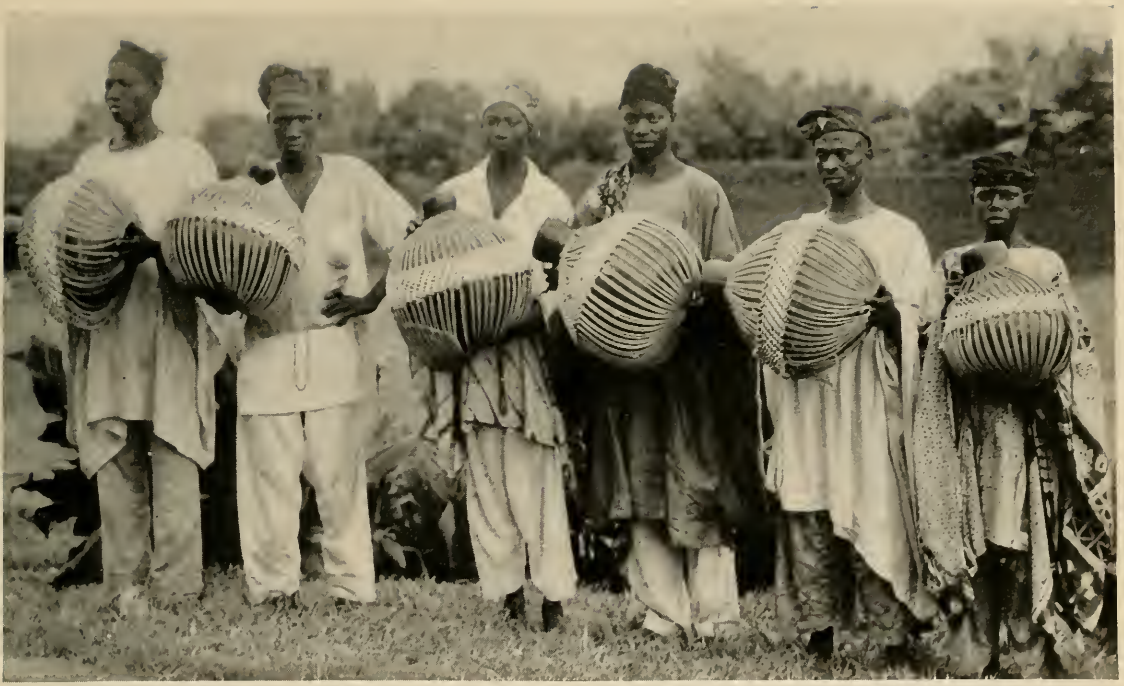
(Left) The present Obba of Benin, in ceremonial robe. His headdress, necklace, bracelets, and foot-coverings are of coral, and the executioner's knife, symbol of power, is constantly near him



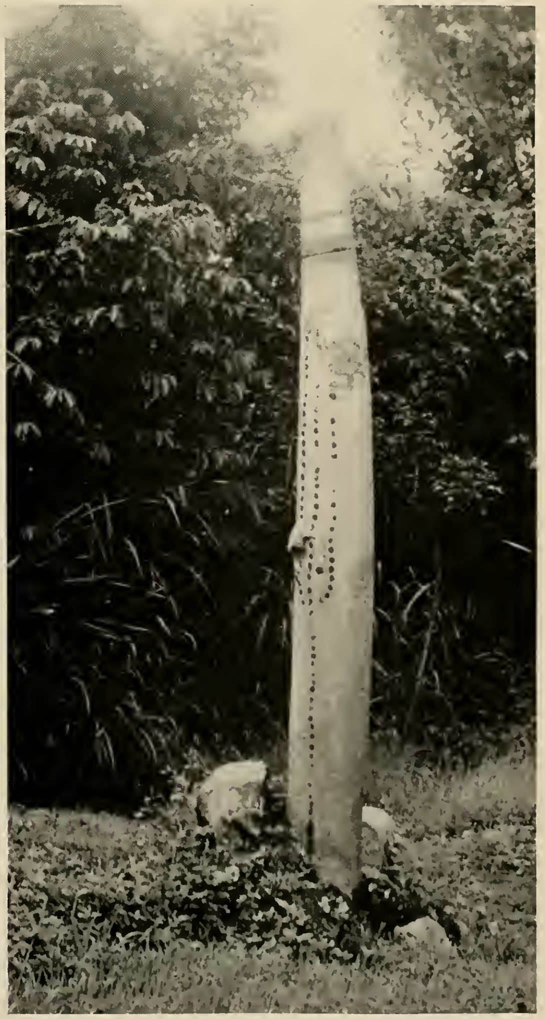
(Above) These aged musicians played the ceremonial music for the great ceremony to the spirits of former Kings. This rite is now performed only once a year for twenty-four hours. It used to last three months, and was an orgy that earned for Benin the name "City of Blood"

(Below) Human sacrificial offerings were formerly made on this juju altar in the King's compound. Now the sacrifices consist of domestic animals. Bronze heads carrying huge carved ivory tusks, brass bells, and staves carved to resemble bamboo and used as rattles, are piled on the altar





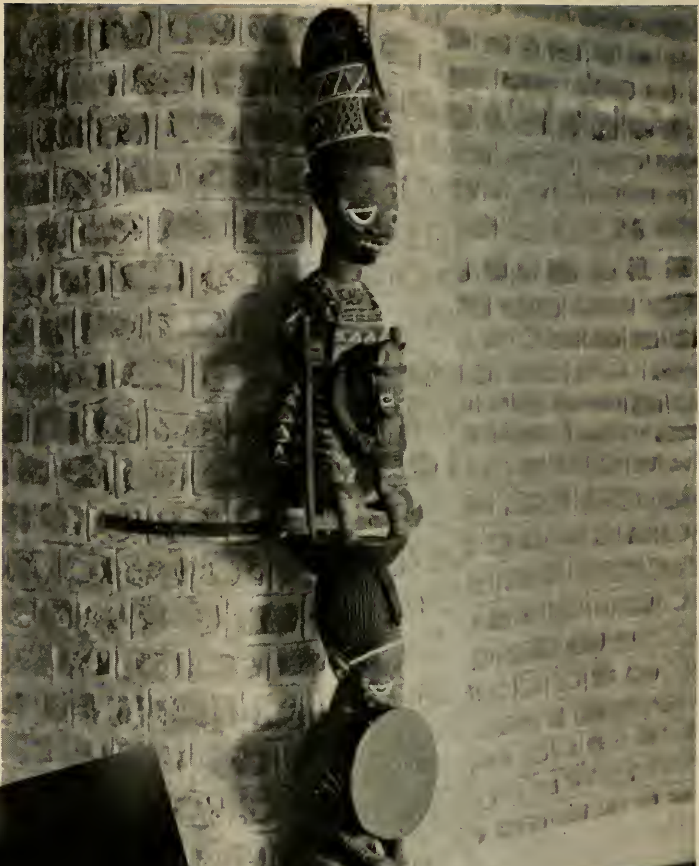
(Above) To show his hospitality, the Awni of Ife called his court musicians to perform their ceremonial music for Mrs. Boulton. This group is equipped with huge gourd rattles

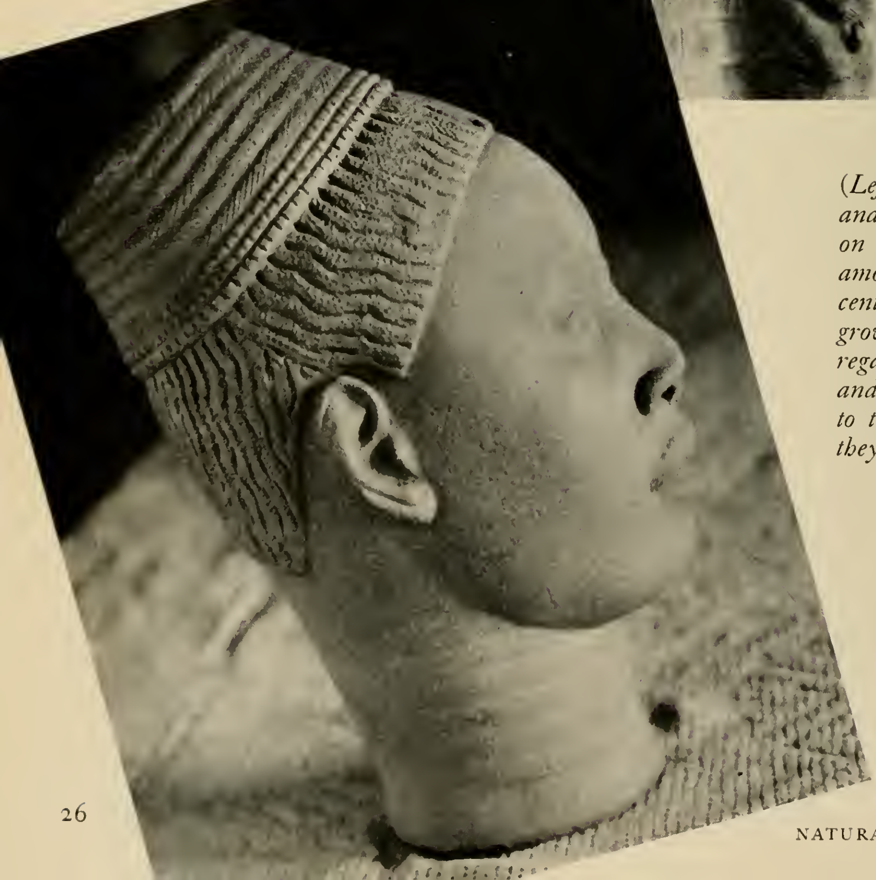


"Opa Awranyan," the staff of a mythical ruler of the Yoruba nation. This granite obelisk marks Awranyan's supposed burial site

The art of carving or drilling in stone such as is shown on this obelisk has long since been lost

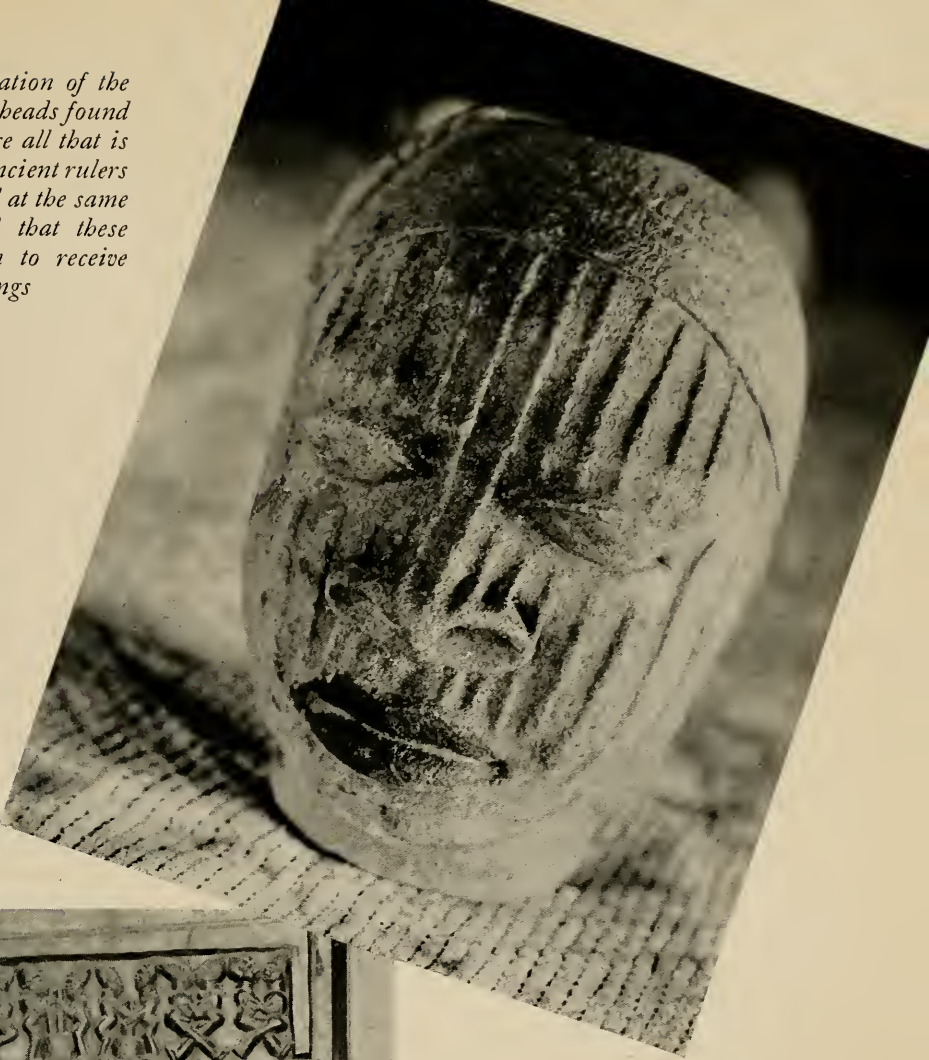
Many carved figures and groups decorate the Awni's palace. In the art treasures of Ife and Benin the African negro has preserved for posterity the traditions and inspirations of his ancestors

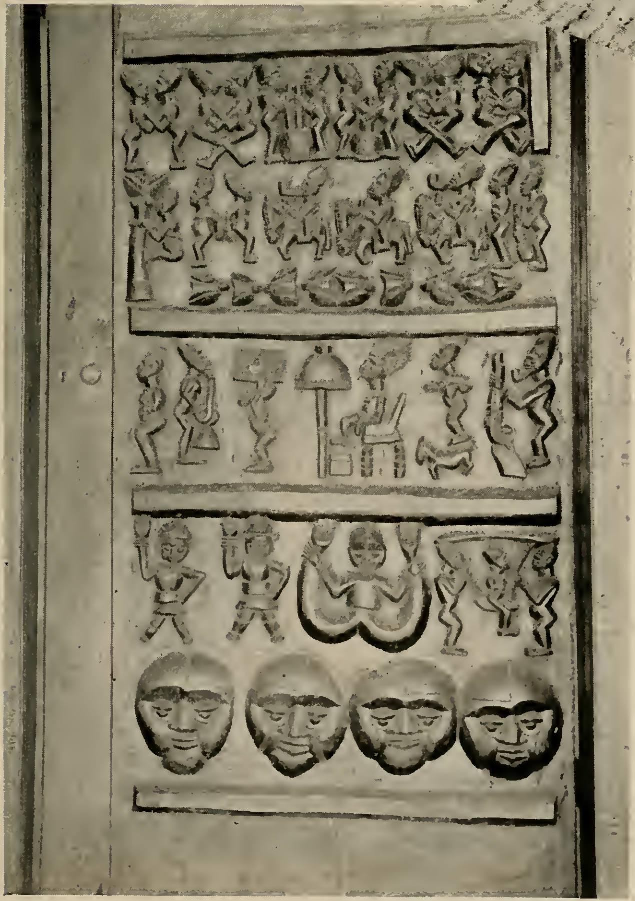




(Left) This terra cotta head and the one at the upper right on the opposite page are among the works of art recently unearthed in the sacred groves near Ife. The natives regard them as sacred objects, and many have been brought to the Awni's palace, where they are carefully protected

The Yoruba explanation of the remarkable sculptured heads found at Ife is that they are all that is left of the bodies of ancient rulers who were deified and at the same time petrified, and that these heads alone remain to receive adoration and offerings





One of the doors in the Awni's palace, bearing scenes from his life represented in carvings. Mrs. Boulton was permitted to photograph the sacred doors and art objects that are so carefully guarded at the Awni's palace

(*Above*) *Bini boys escorting Mrs. Boulton from her morning hunt in the forest.*

Mrs. Boulton was treated with every courtesy during her visit to Benin and Ife, and was successful in obtaining much interesting information about the customs of the natives, particularly their music and their art

(*Above*) *The highway recently opened through the forest to Benin. The present hard-surfaced road follows the path of the early foot travelers, who must have taken many days to cover the distance between Benin and Ife, through the treacherous forest and swamplands*

The picture at the left gives an excellent idea of the height and character of the oil palms growing in the lowland coast country

A Contribution to Maya Architecture

Rio Bec "B"—a temple in the heart of Yucatan is restored in miniature at the American Museum

By Clarence L. Hay

Research Associate in Mexican and Central American Archæology, American Museum

[*Almost all the material for this article was gathered from the photographs of the Peabody Museum of Harvard University Expedition of 1911–12, and the very accurate field notes of the late Raymond E. Merwin, without which the model could not have been constructed.*

Doctor Merwin was an archæologist of the first order, an ideal leader and companion in the trying conditions of the Central American bush, and the news of his death on November 25, 1928, was received with the greatest sorrow by his many friends and colleagues in the Maya field.]

In the year 1908 the French explorer and archæologist, Comte Maurice de Périgny, discovered in the central portion of the peninsula of Yucatan the remains of an ancient city, to which he gave the name "Rio Beque." From later expeditions it has been shown that this site covers a very large area with several localized groups of buildings. The Périgny discovery included a main building to each end of which is attached a two-roomed building and a tower-like structure.

About a quarter of a mile south of these buildings lies the best preserved edifice ever found in this region. Owing to the great density of the jungle, this was not at that time discovered, and was first found in 1912 by R. E. Merwin, field director, and myself as assistant field director, of the Peabody Museum of Harvard University Expedition. The Périgny group we designated by the letter A and called this structure "Rio Bec B." The spelling "Rio Bec" is now in general use.

The members of the Peabody Museum Expedition landed in Belize, British Honduras, in January, and, traveling in a small sailboat about ninety miles, reached Payo Obispo, a small town at the mouth of the Hondo River. We visited some small ruins in that neighborhood. In a motor boat we made further progress up the Rio Hondo, and at Xcopen, a little settlement some forty-four miles from Payo Obispo, we secured mules and set out for the interior.

The trails were in a wretched condition owing to recent heavy rains, and the bush was incredibly dense. We traveled in a northwesterly direction, following up every lead that we could get from the chicle rangers, and discovered a number of small ruins in an indifferent state of preservation, though the walls of some of them were elaborately sculptured and embodied important architectural details peculiar to that region.

Finding the temple

At last on Easter Sunday, on the border line between the State of Campeche and the territory of Quintana Roo, we found our temple. It was so camouflaged with trees and vines that it was practically invisible.

We slung our hammocks between convenient trees, and, armed with axes and machetes, began the job of clearing. Gradually the accumulated verdure of a thousand years fell from the walls and towers, and a structure fifty-four feet in height emerged from the encircling jungle.

The multiple hardships and annoyances of the Yucatan bush were forgotten, for here, at the end of the season, in one unit, were most of the architectural elements we had been finding in fragmentary form all the winter.

No hieroglyphic stelæ were found in the region to identify the age of these structures, but from the study of architectural detail it seems evident that this building belonged to the period between the Great Empire of the Mayas and the Renaissance, and probably was built between 600 and 700 A.D. The two towers with the conventionalized masks suggest the temples at Tikal, Guatemala, but in the Tikal type of temple the walls occupy most of the space, leaving room only for minute shrines in the dark interior. In Rio Bec "B" the rooms are broader and more habitable, and this might be said to represent a transition between the earlier purely religious monuments and the later structures in the cities of Northern Yucatan, of which Uxmal is a famous example. As at Rio Bec, the buildings at Uxmal have usable rooms.

Our ruin, facing east, contains six rooms, two long rooms in the center and two shorter ones at each end. They are all about 16 feet high, with the characteristic Maya vault, and from 7 to 9 feet wide. The center rooms are about 33 feet long, and the end rooms about 17 feet in length. The medial walls are about 4 feet thick, as are the outer walls, with the exception of the great mass of masonry which supports the towers.

Unlike the earlier temples of the Tikal type which were built on high pyramids, it has no monumental base, and on three sides rises directly from the ground. On the east side there is a terrace about 5 feet high extending 35 feet in front of the building. The rooms are all on the level of this terrace, and on the other three sides there is, in effect, a substructure about 5 feet 6 inches high below the level of the rooms.

Construction of the temple

The construction throughout is of rubble, faced with a veneer of finely cut limestone. The walls were originally covered with plaster, but this has largely disappeared, and the beauty of the stone facing is exposed. Built into the southeast and northeast corner is a solid masonry tower nearly fifty-five feet above the ground level. Typical Maya masks representing highly conventionalized serpent heads with upturned snouts, curved eyeballs, and fangs are on the east and west sides.

From the ground to the level of the roof of the building are two rounded corners supporting a steep flight of stone stairs, which are purely ornamental, as the slope is only about eight degrees from the perpendicular. The perforated stone trellis known as a roof comb is in two sections. On each section were originally four human figures of stucco, two in front and two in the rear, but these were in a poor state of preservation and very fragmentary. Below each of the human figures is a conventionalized mask panel.

A large panel, set into the east and west fronts of both towers below the great masks, is topped by a wooden lintel. The panel suggests an entrance to the god's house, for the solid towers contain no earthly rooms and none but a god could climb the steep stairs which lead to the portal.

As in all Maya work, the building is not entirely symmetrical. The central doorway is set slightly to the left as is the double roof comb. An amazing accuracy, however, was reached in the length of the building, for, although the north wall had fallen, the measurements taken on the site indicated a length of 84 feet 1 inch on the east side, and 84 feet 2 inches on the west.

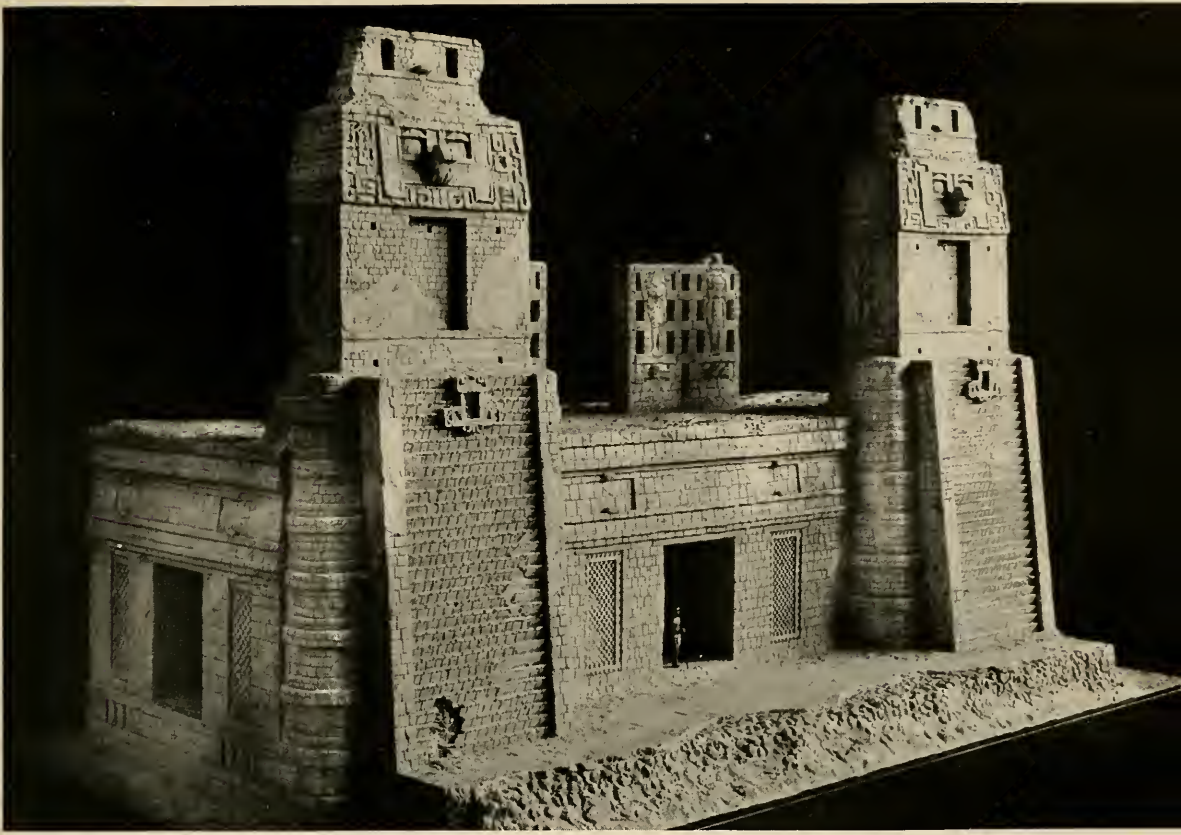
An unexcelled model of a temple

A model, scale 1 centimeter to the foot, has recently been installed in the Mexican Hall of the American Museum of Natural History. It was constructed after plans and photographs of the Peabody Museum of Harvard University Expedition of 1911–12, by Mr. Shoichi Ichikawa of the Division of Anthropology of the American Museum. This model is generally conceded by archæologists to be the finest reproduction of a Maya temple ever constructed. All measurements were followed most faithfully and every stone in the building that could be detected in the original photographs was lined out with meticulous care. A certain amount of restoration was necessary, as portions of the walls had fallen before the site was visited, but the modeler indulged in no flights of fancy and the destroyed parts, except where the design clearly indicated the missing sections, are shown in the model in a state of ruin.

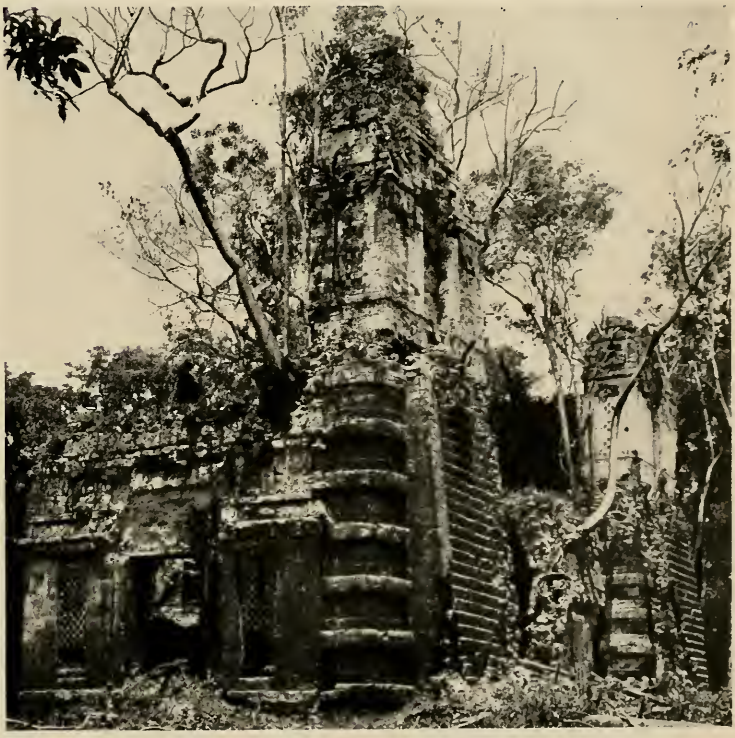
There is an ethereal and elusive quality in Rio Bec "B." As soon as our expedition left the scene, the jungle applied itself to the task of repairing the green mantle that we had torn aside. Since that day in 1912 all attempts to penetrate the veil have been futile. Recently, two successive expeditions attempted to find this temple, and although the other buildings in the group were rediscovered and several new ones added to the site, "B," only a quarter of a mile away, has remained invisible.

The jungle is a jealous custodian of its mysteries.

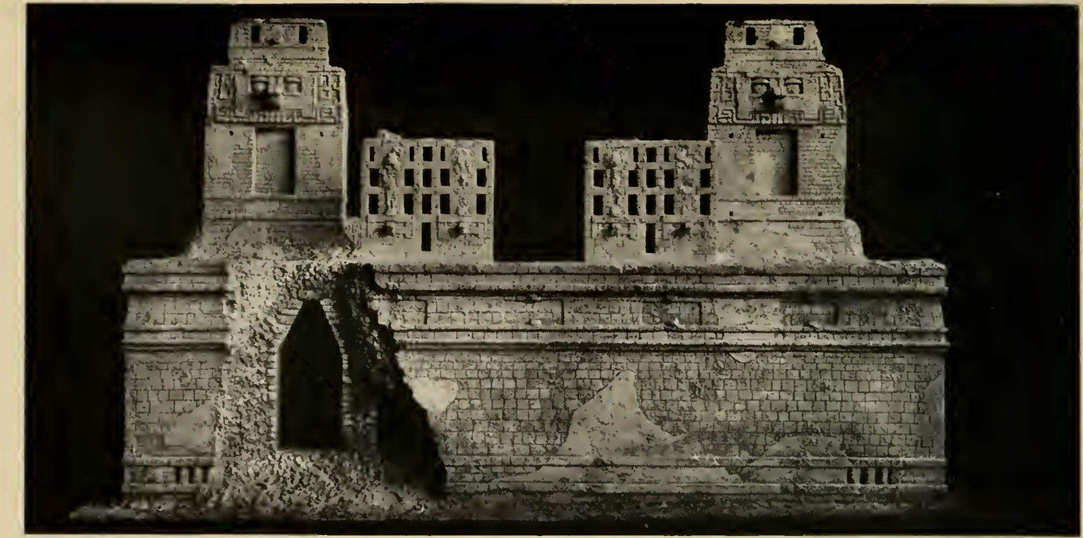
A Temple in the Jungle



The model — southeastern view. The purely ornamental nature of the stairs is evident at this angle. It is impossible for a human being to ascend them. Panels with checkerboard design decorate the walls



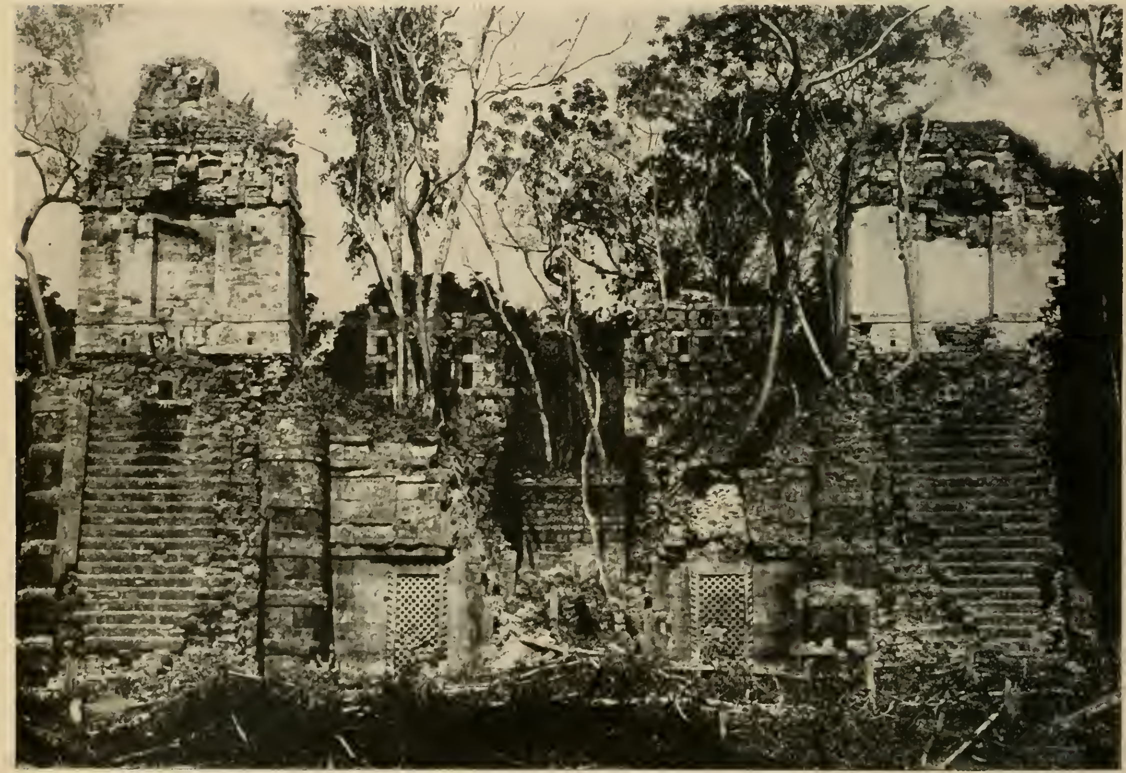
The original temple from almost the same viewpoint as the model above. The rounded corners which support the stairs are characteristic of the buildings in this area. One of the weaknesses in Maya architecture is the use of wooden lintels over the doorways. In this door the lintel is still in place.



(Above) Western elevation of the model. An opening appears in the model to show the construction of the interior rooms. The fine stone facing is carefully worked out and the original plaster surface is indicated

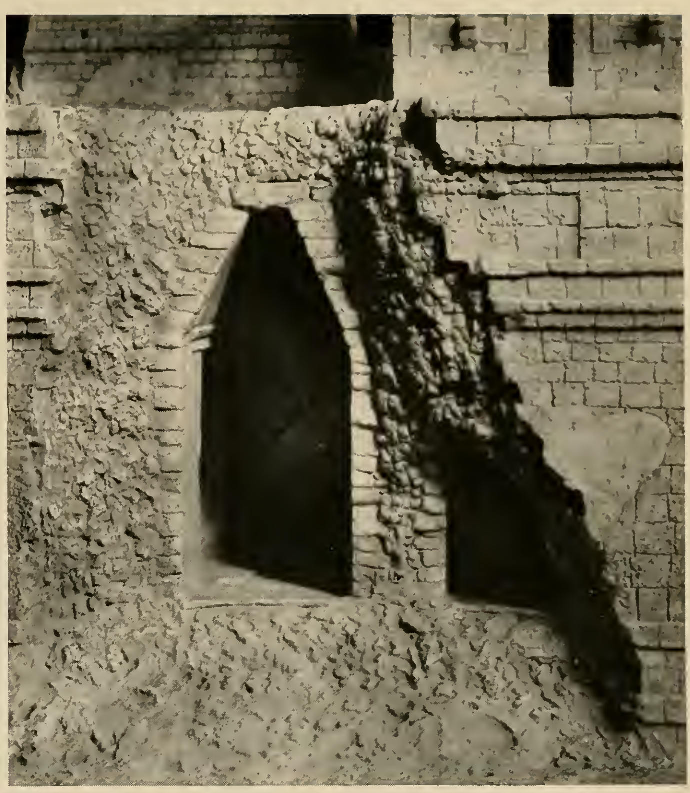
(Left) At the end of the day hammocks were slung between trees

(Below) The eastern façade after clearing. When discovered, the building was almost completely hidden by vegetation



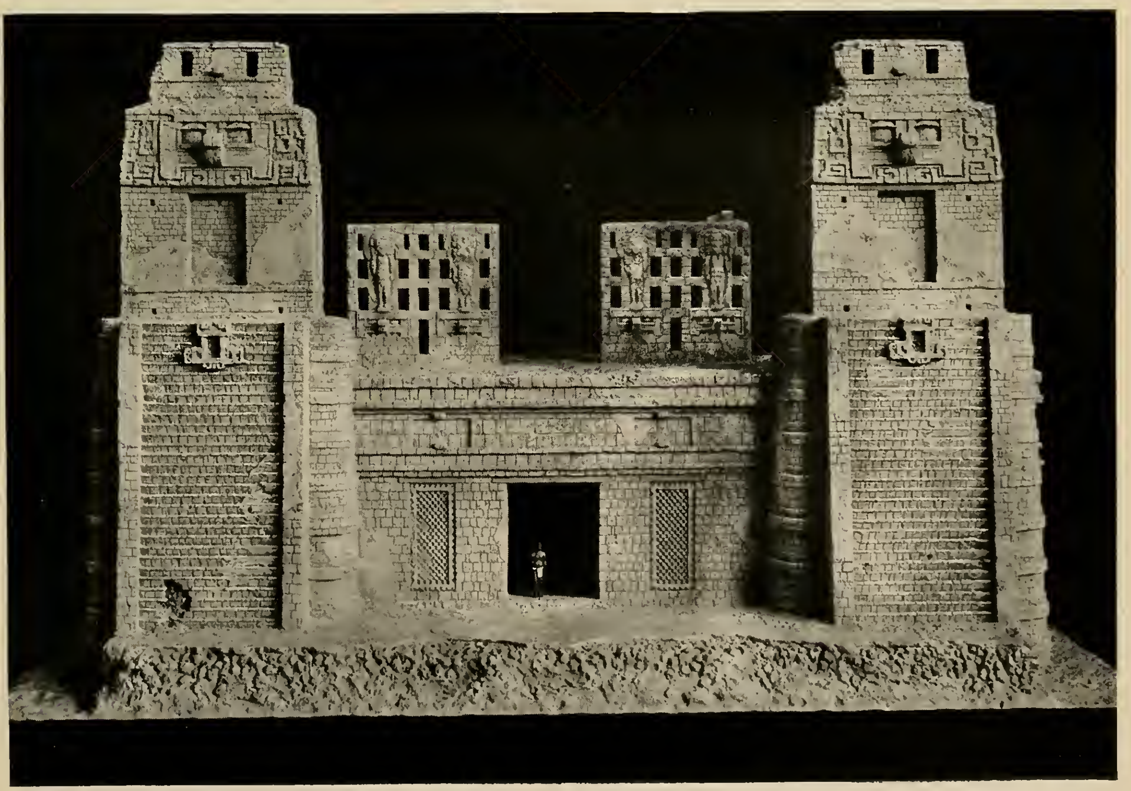
The Maya Temple

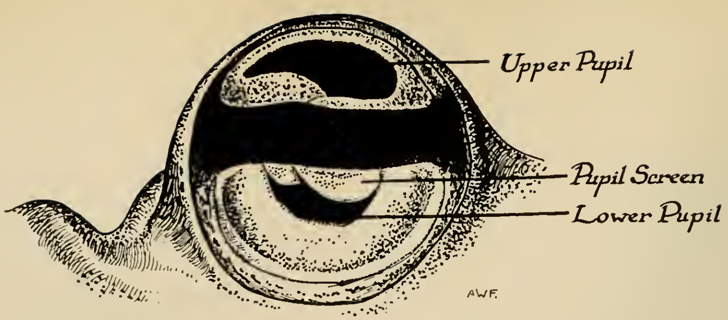
Cross section of a typical Maya room. Note the capstone at the apex. An unusual feature is the lack of an offset at the spring of the arch. A stucco molding is substituted



East elevation. Only a portion of the broad terrace is reproduced in the model. The rooms are on a level with the terrace. The towers are of solid masonry, rising nearly fifty-five feet from the ground level.

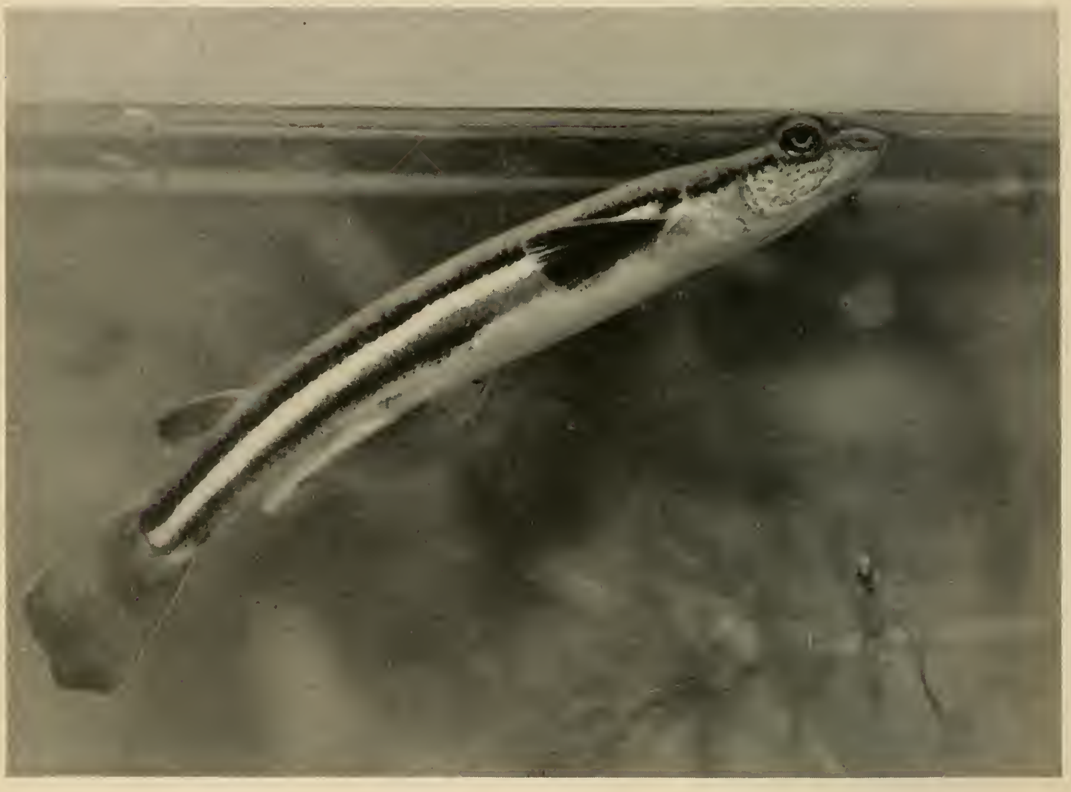
Human figures of stucco appear on the double roof-comb





THE EYE THAT SEES IN AIR AND WATER

The four-eyed fish has only two eyes, but each has become divided into an upper and lower section by ingrowth of the iris. The lower pupil is shaded from the glare of the surface film by a double screen which, like horse "blinders," prevents the water-eyes from looking anywhere but in one direction, namely downward, where the fish's enemies prowl about



THE FOUR-EYED FISH

In the opaque waters of the American tropics the four-eyed fish has developed the habit of floating with the upper half of each eye thrust above the surface. In this manner the fish can spot from afar prey borne to it on the surface of the current. In correlation with this habit the upper half of each eye has become modified into an organ of efficient vision in air, while the lower half retains the near-sightedness of the normal fish eye

The Four-eyed Fish

A fish that sees both above and below the water surface—The first stage in the evolution of vision in the air

By G. Kingsley Noble

Curator, Experimental Biology, American Museum

Recently two pairs of the famous four-eyed fish of the American tropics were brought to the American Museum alive. These were procured in southern Mexico by Mr. T. McDougall, a distinguished naturalist who has traveled extensively in that region. The specimens represent the species *Anableps dowii*, the most attractive of the genus.

The optical equipment which enables this fish to see in the air as well as in the water makes it unique in the whole series of backboned animals. Inhabiting waters which are often so muddy that objects cannot be seen for any distance, it swims almost continuously at the surface with its "air-eyes" thrust above and its "water-eyes" directed downward. It has specialized in feeding on the floating material which it encounters in its wanderings in the dual realm of air and water.

A rare aquarium species

Although *Anableps*, as the fish is technically called, has been mentioned frequently in the writings of naturalists for a century and a half, it is still one of the rarest species in aquaria. There are very few records of the fish having reached northern aquaria alive, and fewer still of its having lived there for more than a short time. The four *Anableps* which Mr. McDougall collected and with great trouble brought to the Museum have been installed in one of the large tanks in the greenhouse on the roof of the African Building. These "queer fish" have proved a very important addition to the collection of live animals under observation in the biological laboratory.

The double pair of eyes which *Anableps* has developed have an important bearing on the evolution of vertebrate animals from water to land-creatures. Perhaps the most stupendous step in the entire evolutionary change from fish to man occurred when a certain group of fish living in the drying pools of Devonian times had to adapt themselves to life on land. This change, which took place probably 400,000,000 years ago, involved a tremendous reorganization affecting many parts of the bodies of the animals undergoing it. For the moment we may consider only the eyes.

New requirements for land existence

The fish which left their pools for an unknown world of dry land and sunshine had to make over their short-sighted eyes into structures which could see objects accurately at a distance. Water is relatively opaque, and distant vision is consequently not possible in this medium. On land ability to see objects at a distance was not only possible but a necessity. The changes in the eye which were occasioned by the new existence on dry land were more complex than might be supposed. The lens of a fish's eye is large and spherical, and for distant vision in the air the lens had to be flattened, reduced in size, and moved back from the cornea. How this was actually accomplished we shall never know, since the soft parts of animals are not preserved as fossils.

What we do know, however, is that the first land vertebrates, having evolved directly from fish, were devoid of necks. In order to secure an unobstructed view, they had to develop muscles to periscope their eyes above the surface of their heads. The eye in dry atmosphere, further, had somehow to be kept moist. The first land vertebrates therefore gradually gained protective eyelids and glandular mechanisms which would keep the cornea moist and yet free from dirt.

The reptiles early made an advance over the first land vertebrates in developing special muscles to change the form of the lens by pressure from the outside. The birds in turn improved on this compressing mechanism considerably. As a result, a recently hatched chick may have its eye focussed on a worm in front of it and in a moment throw the head back to focus on a passing hawk.

The mammals, which sprang from a different group of reptiles, evolved an entirely different mechanism for rapidly changing the focus of the eye. When at rest, the mammalian eye is far-sighted like that of the first land vertebrates, but the lens is flatter than that of the Amphibia and it is held in place by a series of delicate fibers which keep it flattened. As we grow older the lenses of our eyes lose their elasticity and the delicate fibers holding them can no longer change the curvature of the lenses. Hence, our eyes do not focus as efficiently as in youth.

Anableps has none of these special devices of reptiles, birds, and mammals to change the form of the lens. Its aërial eye merely represents the first stage in the evolution of vision in the air. *Anableps* was confronted with the problem of developing eyes for vision above the surface while at the same time it could not afford to give up its water-eyes entirely. Nature in this dilemma modified half of each eye for vision above the surface while retaining the other half for duty below the surface.

Two pairs of optical equipment

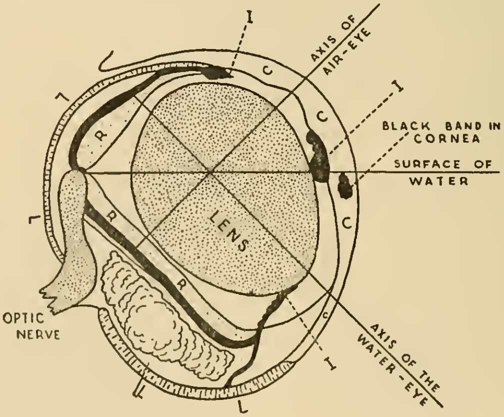
During the early years of the last century the four-eyed fish attracted the attention of the great anatomists who studied the wealth of animal life sent to Europe from the British, French, and Dutch colonies in northern South America. As long ago as 1803, a German anatomist, Schneider, very accurately described the structure of the fish's two pairs of optical equipment. Even at that time it had been established that the four-eyed fish has only one pair of eyes, but that each eye is divided by an opaque band into upper and lower sections, the former adapted for vision in the air and the latter for gazing under water. Each pupil is divided in two by ingrowth of the iris. For distant vision a lens must be well back of the cornea, while for close viewing the lens must be in the reverse position. *Anableps* has only one pair of lenses but they accomplish this double function by being egg-shaped, with the long axis directed into the water and the short one into the air.

The "air-eye"

The "air-eye" is not equipped with glands to keep it moist in the dry atmosphere. Consequently, the fish must frequently dip its eyes below the surface. McDougall observed the creatures in their native haunts ducking their heads below the surface, and he guessed correctly the reason for this habit. Apparently no other naturalists, who have studied *Anableps* in the field, have called attention to this habit.

Nor has anyone previously noted that the lower pupil is shielded by a double shade formed by the projecting parts of the iris. This double screen no doubt prevents surface-reflection from striking into the lower pupil. The accompanying sketch of the eye of a living fish shows the lower pupil-screen in normal position.

All species of *Anableps* have the strange bifocal eyes which, far from being merely a curiosity of nature, actually show us an important stage in the evolution of the eyes of higher forms, including our own.



C-cornea
I-iris
R-retina
L-sclerotic capsule

CROSS SECTION OF THE DOUBLE DUTY EYE

As shown in section, each eye is equipped with only one lens. In order to accomplish near vision through the lower pupil and far vision through the upper, the lens is egg-shaped and receives light rays through both axes at the same time

Exploring the "Mighty Chindwin"

A great river, magnificent jungle, head-hunters, unknown territory, yield adventure to an American Museum collecting expedition in inner Burma

By Arthur S. Vernay

Field Associate, Department of Mammals, American Museum

The plan to penetrate the Chindwin region of inner Burma grew out of a conversation that I had several years ago with Mr. S. F. Hopwood, Chief Conservator of Forests of Burma.

At the time, we were collecting specimens in lower Burma for the South Asiatic Hall of the American Museum of Natural History. Mr. Hopwood pointed out to me the exceptional rewards which this remote section would yield to a scientific expedition. The Chindwin River, or the "Mighty Chindwin" as he called it, wound through a country which in many parts was unknown, a region buried in dense jungle, unvisited by white men. Interest was added by the fact that a journey to this region would take one within the territory of the head-hunting Nagas.

Thus the seed was sown. From time to time we further discussed the possibilities of an expedition, and later I took up the matter with members of the scientific staff of the Museum. When I was informed that no animals from the Upper Chindwin country were in the collections of the Museum and that such specimens were greatly to be desired, the importance of the undertaking became apparent.

Personnel of the expedition

It was in December, 1933, that Mr. Hopwood offered his help and also expressed his willingness to do all he could to further the objective, with the result that definite plans were made for the expedition to form in Rangoon early in January, 1935.

The personnel had been carefully chosen. We were fortunate in being able to have an old friend of mine, Mr. Randolph Morris, the foremost "shikari" (hunter) of southern India; also Major Rowley, an experienced shikari, and Mr. Charles McCann, assistant curator of the Bombay Natural History Society. And finally, a few months before the expedition set out, Mr. H. C. Raven, associate curator of comparative and human anatomy at the American Museum, fortunately was able to join us. Mr. Hopwood accompanied the expedition for a few weeks. The task of organizing fell chiefly to his lot, and the success of the expedition is evidence of his thoroughness in these preparations.

The departure

Major Rowley and I flew from Paris to Rangoon, arriving there on the morning of January 6. Two days later we all departed by rail for Mogaung in northern Burma. From there a motor journey of a few hours took us to Nanyaseik, where our mule train was waiting. Including interpreters, skinners, Burmese bearers and cooks, and Yunnanese muleteers, our party numbered fifty-eight persons.

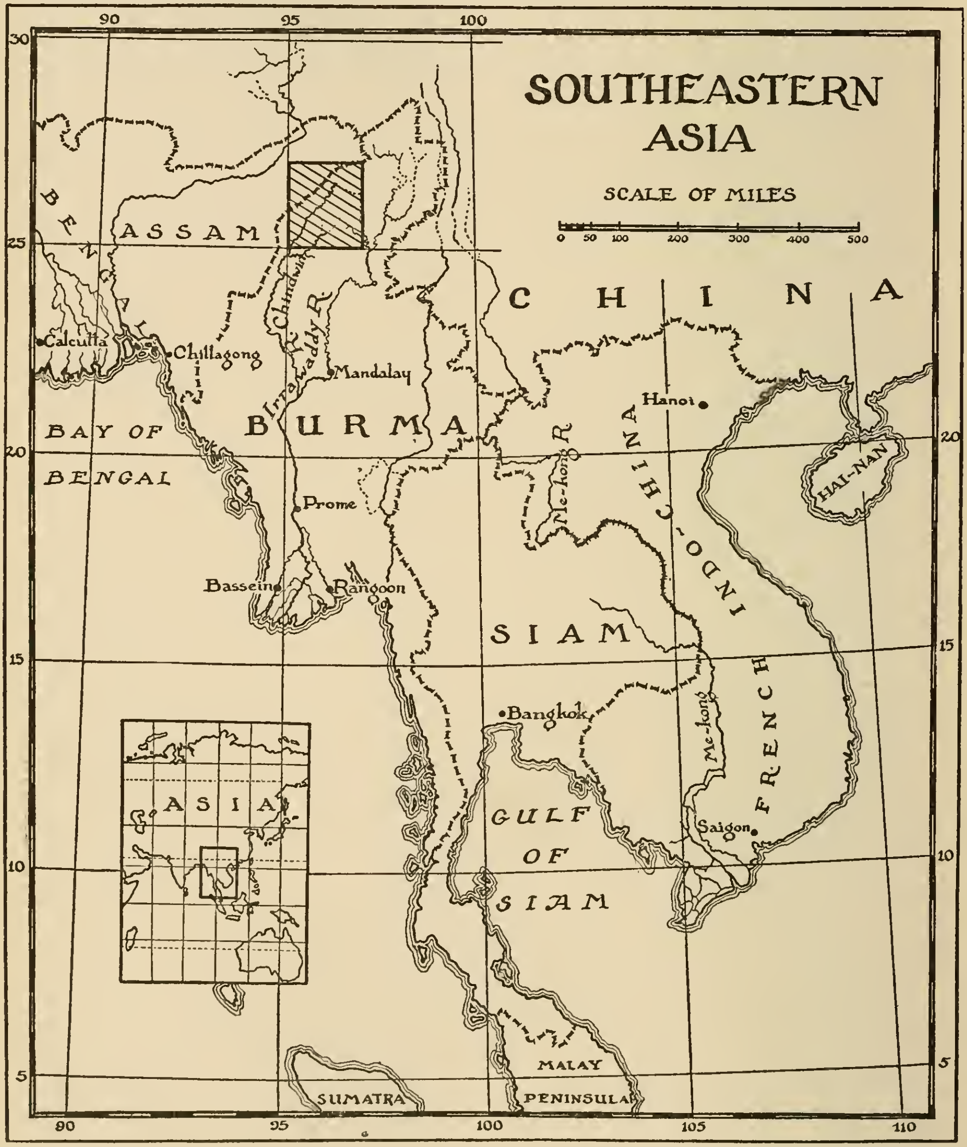
There were 110 mules, and the manner in which each of the Yunnanese drivers handled the five animals under his control was astonishing to witness. A driver would give a curious call and immediately his five mules would come to hand and be saddled. This process was repeated until all the animals were laden. The two leading animals were gaily decked out with brilliantly colored plumes of dyed goats' hair, and a mirror was put into the harness to keep away the spirits. And away we went.

A march of nineteen miles took us into heavy jungle. Railways, motor- and cart-roads were left behind. We were on jungle paths.

At Lonkhin, about fifty miles from the railroad, we halted for a few days to visit the jade mines. A description of these mines would make a story in itself, for it has been from these and other sources in this region that the famous jade of China has been drawn for a century and a half and carved into the objects of art that now are prized by us as priceless museum pieces. The prevalent idea that all jade comes from China is an error, for there are no sources of imperial jade in China. The great jade mines of the world are in northeast Burma and on the borders of Burma and Yunnan.

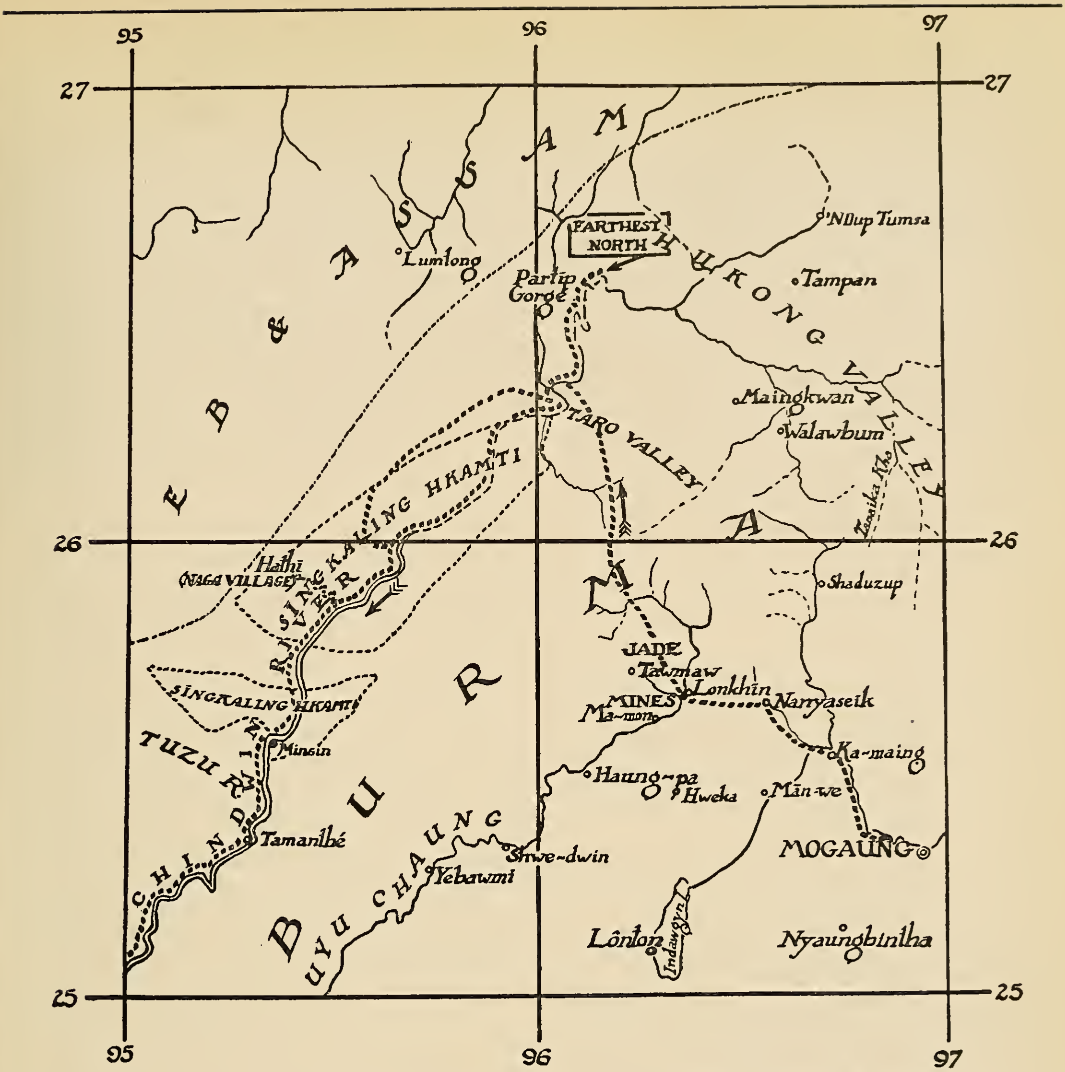
But we must return to Lonkhin and continue our journey. I will not attempt to describe the various marches, which covered from ten to twenty miles per day, according to the topographical conditions and camping facilities. The length of time we stayed in any place depended entirely upon what we expected that place would yield; if specimens were obtainable we tarried, if the prospects were unpromising we forged ahead.

The first nine marches brought us to the


SOUTHEASTERN ASIA
SCALE OF MILES
0 50 100 200 300 400 500
90
95
100
105
110
30
25
20
15
10
5
BENGAL
ASSAM
Chindwin R.
Irrawaddy R.
Calcutta
Chittagong
Mandalay
BAY OF BENGAL
BURMA
Prome
Bassein
Rangoon
CHINA
Hanoi
Me-kong R.
INDO-CHINA
FRENCH
HAI-NAN
SIAM
Bangkok
Me-kong
Saigon
GULF OF SIAM
MALAY PENINSULA
SUMATRA
ASIA

Recent Exploration in Southeastern Asia

The Vernay-Hopwood Expedition set out from Rangoon and, after traversing lower Burma, entered the little known area in the north indicated by cross hatches, which was the field of its major exploratory activities


95
96
97
27
26
25
ASSAM
BURMA
BURMA
HUKONG VALLEY
FARTHEST NORTH
Partip Gorge
'NDup Tumsa
Tampan
Lumlong
Maingkwan
Walawbum
TARO VALLEY
SINGKALING HKAMTI
Hathi
NAGA VILLAGE
SINGKALING HKAMTI
TUZU R.
Minsin
CHINDWIN R.
Tamanthé
Shaduzup
JADE
Tawmaw
Lonkhin
MINES
Ma-mon
Nanyaseik
Ka-maing
Haung-pa
Hweka
Man-we
MOGAUNG
Shwe-dwin
Yebawmi
UYU CHAUNG
Lônton
Indawgyi
Nyaungbinlha

The Route of the Expedition

The heavy dotted line traces the course of the Vernay-Hopwood party to the upper reaches of the Chindwin River

upper waters of the "Mighty Chindwin." Those nine marches took us farther and farther into the unknown parts of Burma. Fairly early in this stage of our travel we left the Burmese members of the party behind, for beyond a certain village the Burmese were not allowed to go.

We were now in the country of the Kachins, a fine, hardy, warlike race of hill men. We had learned a few Kachin words to assist us when we should meet these people. Information of this sort had been given us by Mr. G. K. Stanford, District Commissioner of Myitkyina, who had favored the expedition with every possible assistance.

On meeting the head man of the village we greeted him with, "*Duwa é Grai Kaji*" ("O Chief, are you well?"). He answered "*Kaji*," meaning "Very well," and we were friends. Those who had told us that a greeting and a smile would meet with ready response from the Kachins, had been correct. "*Grai Kaji*" soon became a camp expression.

The Kachins

The Kachins are a most interesting people. They are good hunters, and are fierce and determined in the protection of their own people. They are neighbors of the Shans, Chins, and Nagas; but there is almost no intermarriage between these peoples. The Nagas, Kachins, and Chins are much finer specimens than the Shans.

The expedition created great interest among all these people, and the farther we got into the country, the more interesting we became to them and they to us. In one instance quite away from civilization a man and his wife and daughter had heard of our being in camp and made a three-days' journey over the hills in order to see "the white men." They brought with them as presents four eggs and an interesting piece of hand-woven Chin linen which was most effectively embroidered. The eggs left much to be desired, but were accepted in the spirit in which they were given. In return we presented a bag of salt.

Items of barter

In each instance where we were in touch with villages, the head man would bring us presents of eggs, chickens, bananas, etc. We responded with presents of salt, tobacco, blankets, jerseys, and various other articles such as needles, cotton, and thread.

Unfortunately our supply was limited in one of the most popular and desirable items of barter. I refer to the ordinary safety pin. Safety pins are prized as earrings, one pin being linked to another; and the short jackets the natives wear would often be decorated with a dangling chain of safety pins. They serve as an invaluable medium of trade, and in the future they will be included in large quantities as part of our equipment.

In the Upper Chindwin extremely dense jungle is found. In the perpetual green the minimum temperature during our stay ranged from 40° to 56°, while the maximum ranged between 70° and 84°. The rainfall is about 100 inches a year, and the dews are very heavy.

Collecting begins

For food, pheasants, partridges, geese, and various other game birds were brought in, but the country could not be relied upon to supply a great deal of sustenance. We were not hunting for food, however, but for specimens: mammals, birds, reptiles, and fishes, as well as for anthropological material from the various tribes.

Our entry into a village always met with considerable surprise and interest. Our first endeavor was to ask the inhabitants to help us in collecting specimens. For anything brought in we gave a present of a small amount of money according to our estimate of the value. Anything we desired particularly was paid for accordingly. For instance, the big bamboo rat which was most desirable (this species being different from others we had formerly collected in lower Burma) was valued at one rupee (35 cents), with the result that we got a dozen specimens. Without the help of the people we could not have obtained them. Rare birds trapped were listed somewhat higher.

The natives were skillful hunters and trappers, and knew every inch of the terrain. Thus, although we ourselves were collecting as diligently as we could, the local inhabitants were the crux of the situation.

In certain parts of the country there were a number of tigers. Some of the members of the party who particularly wanted to obtain this animal built machans (sheltered platforms up in the trees) near a "kill" and sat in them waiting for the tiger to come back to his quarry, there being no other way of hunting tigers in this almost impenetrable jungle. But the tiger would not return, and they met with no success.

Nocturnal hunting

Elephants were quite numerous. These animals do an immense amount of damage to the crops of the inhabitants. We were not interested in hunting them, however.

Night hunting was done with electric headlights. Our defense of the use of this method was that we were collecting for science, and a number of highly desirable specimens not otherwise obtainable could be brought in by this means. Owls, nightjars, lizards, fishing cats, and a slow loris, a truly nocturnal animal, were procured. Regarding the latter creature, the natives told us that only a few persons had ever seen it, as it only came out at night, and that it never ate anything, but lived "on the rays of the moon." They did not go into the question of what happened when there was no moon.

All our endeavors interested our friends, the savages, enormously, and they entered into the spirit of the game and gave all they could of their jungle lore in order to help us. One can realize the importance of having these people interested and friendly by the fact that on one occasion we were surprised and delighted to hear that one of the chiefs of a large territory had given instructions that thirty-five miles of road were to be cut through the jungle so that the expedition could pass. In another instance forty miles of road were cut. All this resulted through the kindness of Mr. Stanford, who had made it known that a large expedition from America was coming through their country.

Masks of natives

Mr. Harry Raven offered useful suggestions in connection with the particular "desiderata" of the Museum. He accomplished one particular objective which on our return astonished the various officials to whom we described it. This was taking plaster cast masks of people of the various tribes. These tribes are very superstitious, for their religion is "Nat worship," the worship of the spirits of the jungle. Anything that seems to them in the slightest degree uncanny disturbs and terrifies them, and taking a plaster cast of one's face has a certain uncanny aspect. However, we wanted the casts, so it had to be done. How could we persuade them to submit?

We asked several men and women, offering a reward of one rupee; but they would not hear of it, although the rupee was extremely tempting. Then Mr. Raven had a bright idea, namely, that I should be "operated" upon in order to give them confidence. This was done, and I think the rupee given to the others who underwent the ordeal was very well earned. I did not find it an agreeable experience. Let me describe the procedure:

Vaseline is first applied to the eyebrows, eyelids, and around the edges of the hair, and two glass tubes are inserted into the nostrils. One has to keep one's eyes and mouth tightly closed when the wet plaster is lightly sprinkled on the face. The entire face is covered with it in a thin layer and then a large quantity of plaster is spread over and it is left to harden, which takes from fifteen to twenty minutes. Breathing through the two glass tubes is not easy. And when the operation is finished the victim blinks his eyes and thinks the rupee was well earned. Our muleteers and bearers who saw this performance would assure the various people as we went along that it was "perfectly all right." In this way a number of masks were obtained without great difficulty, although it required a considerable amount of persuasion. The result is that we have extremely good casts of Burmese, Shans, Kachins, Chins, and Nagas.

Each expedition has some episode which stands out in one's memory apart from everything else. Our visit to the head-hunting Nagas was this episode.

It was a rare experience. We enlisted the services of a "Sawbwa" (a territorial Sawbwa chieftain) with the promise of a shotgun and 200 cartridges, to take us to the village, which lay about twenty miles from our camp. This particular village with other villages had within the last few months made a raid on another settlement forty miles away and brought back fifteen heads. It was with keen anticipation that we set out early one morning for this destination.

The head-hunting Nagas

It was not an easy journey. From an altitude of 680 feet we had to go to 2100 feet. Ordinarily, this would be simple, but there were saw-tooth hills intervening which made the march, up 1000 feet, down 500 feet, and so on, quite tiring. It was not until late in the evening that, to our delight, we saw the small village, Hathi, tucked away in the hills, the home of the Nagas.

On our approach, one magnificent specimen of humanity came out, sat on the top of the hill, and awaited our arrival. Our desire to see the village was explained to him. The Chief did not appear to be unduly impressed, but nevertheless met us with courtesy, and we soon became good friends.

The entrance to the village was between two large tree trunks. Nailed on these were human hands and parts of arms and, farther into the village, the skulls which had recently been obtained, gruesome relics of religious fanaticism.

During the day which we passed with these people they danced the Head-hunting

Dance, and a more impressive savage dance I have never witnessed. We were deeply stirred on hearing the chanting which heralded the approach of the procession entering the village. Louder and louder it grew, and then the participants came upon the scene. The dancers were dressed in their war regalia, the most conspicuous feature of which was the headdresses, decorated with boars' tusks, hornbill feathers, and goats' hair dyed a brilliant red. Spears and heavy knives were their weapons. The long knives of the Nagas, when they are not being brandished, are carried in holders hanging at the back, parallel to the spine. There were magnificent voices in the weird ceremonial chorus. The dance continued far into the night, long after we had gone to bed.

The next morning we departed, leaving these strange people to their secluded existence, which seems happy in spite of the possibility that at some time they may lose their heads.

Results of the expedition

The unpleasant part of an expedition is that it comes to an end. I will leave it to Mr. Raven to tell the story of the scientific side of the journey and of the large collection brought back, which includes 900 mammals, 800 birds, reptiles, and fishes, as well as important anthropological material.

This is only a brief outline of our journey through dense, magnificent jungle, a great river, and interesting people.

Burma, of which the section discussed in the foregoing article is one of the least accessible, is the largest province of India. Its population, though twice as great as that of Texas, whose area is approximately the same, is sparse in comparison with peninsular India and with China, which it touches on the northeast.

Agriculture is the chief occupation of the people. Rice is by far the most important crop, the production of which averages more than half a ton per head of population. The alluvial lands of the delta and the valleys of the Irrawaddy, Chindwin, and Sittang are the most productive areas, and support the major portion of the population. The hill sections of northern Burma are inhabited sparsely by primitive tribes.

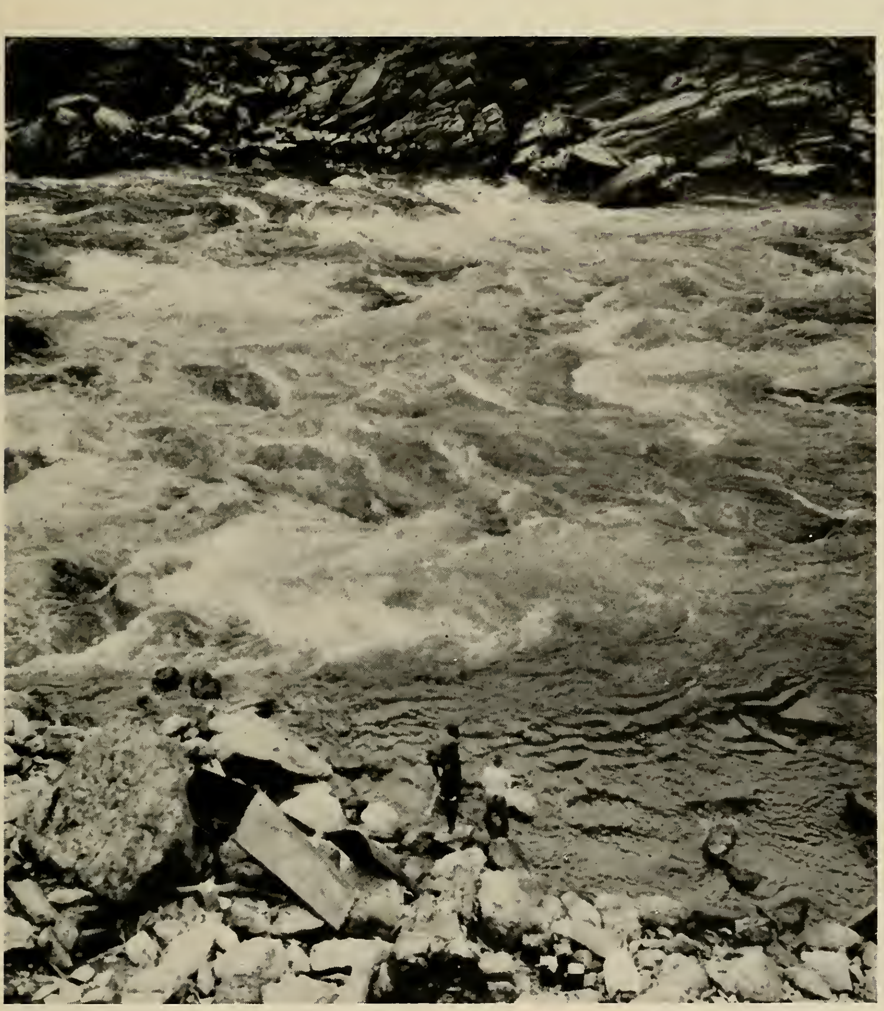
The people of Burma are predominately Mongoloid, but many racial subdivisions are recognized among them. It is believed that the prehistoric inhabitants were a Negrito race, of which the modern natives of the Andaman Islands, not far distant, may be considered survivals. Burma's present Mongoloid derivation is explained by successive waves of migration from the north, which have continued in the border regions down to quite recent times.

About nine-tenths of the population embrace Buddhism. Spirit worship prevails, however, among the hill tribes, such as those visited by the Vernay-Hopwood Expedition in its traverse of the Chindwin country north to within a hundred miles of the Tibetan border.

Little more than a century ago inner Burma was unknown to Europeans except for the Irrawaddy River as far as the center of the province, and even today sections in the north remain obscure. Difficulties of transportation and hostility of the natives are the chief hindrances.

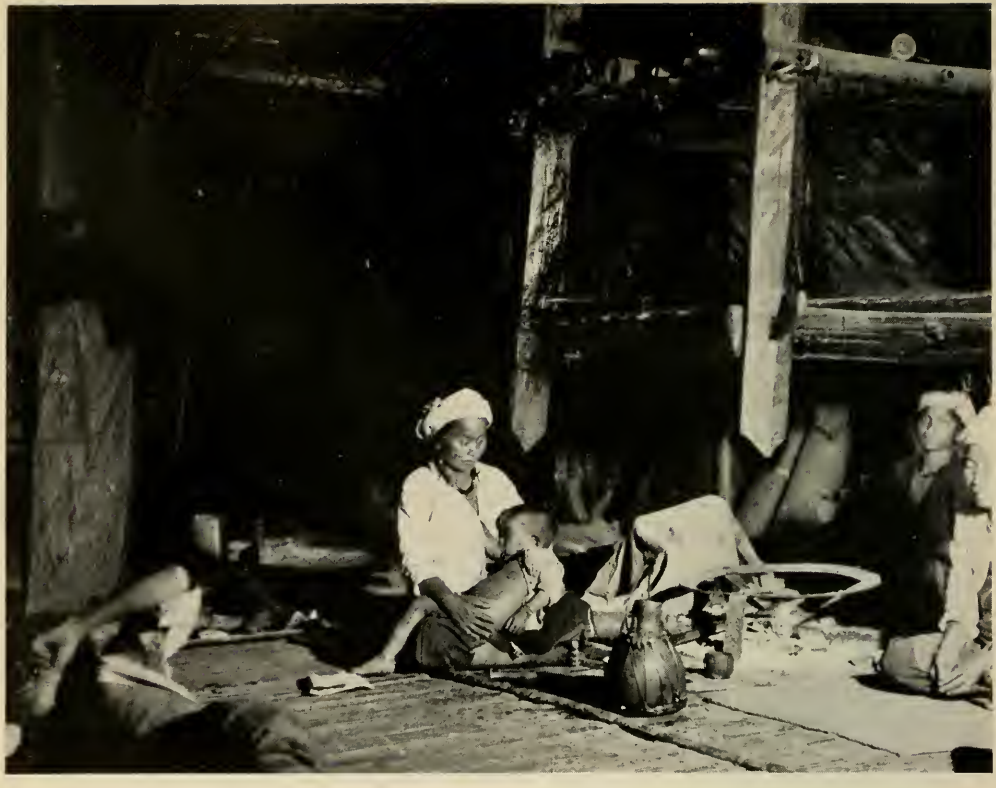
[*Republication of any illustrations appearing in this article is forbidden unless expressly authorized.*]

Along the Chindwin in Northern Burma



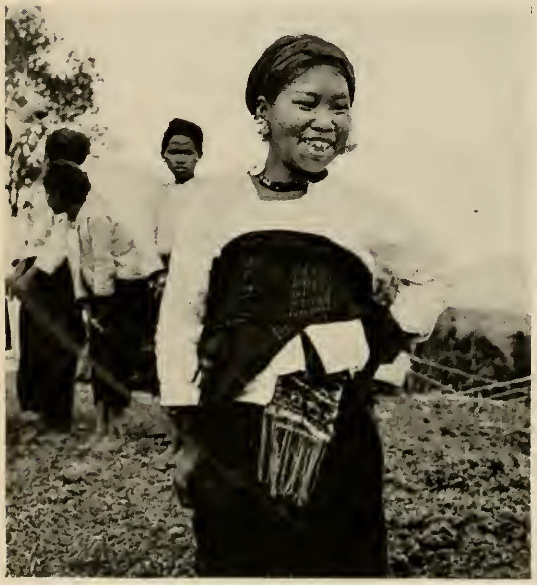
The Chindwin is the largest tributary of the Irrawaddy. The Vernay-Hopwood Expedition followed it through little-known regions of northern Burma, where its upper reaches are broken by falls and rapids. The members of this expedition were the first white men to fish in Kyaukse Rapids, shown above

Extremely dense jungles flank the upper Chindwin

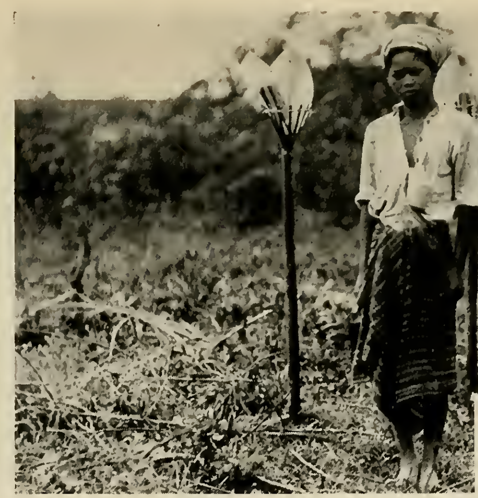


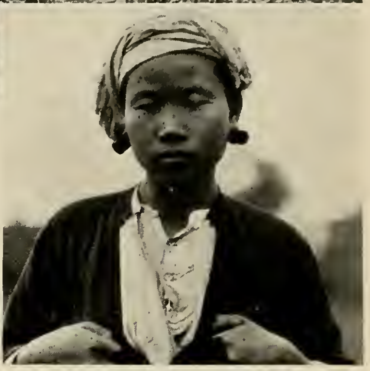
Interior of a Kachin hut, photographed with flashlight. The Kachins are hardy, warlike hillmen, who exhibit staunch determination in the protection of their own people. Complex laws govern marriage within their clans

Kachins—Natives of Inner Burma



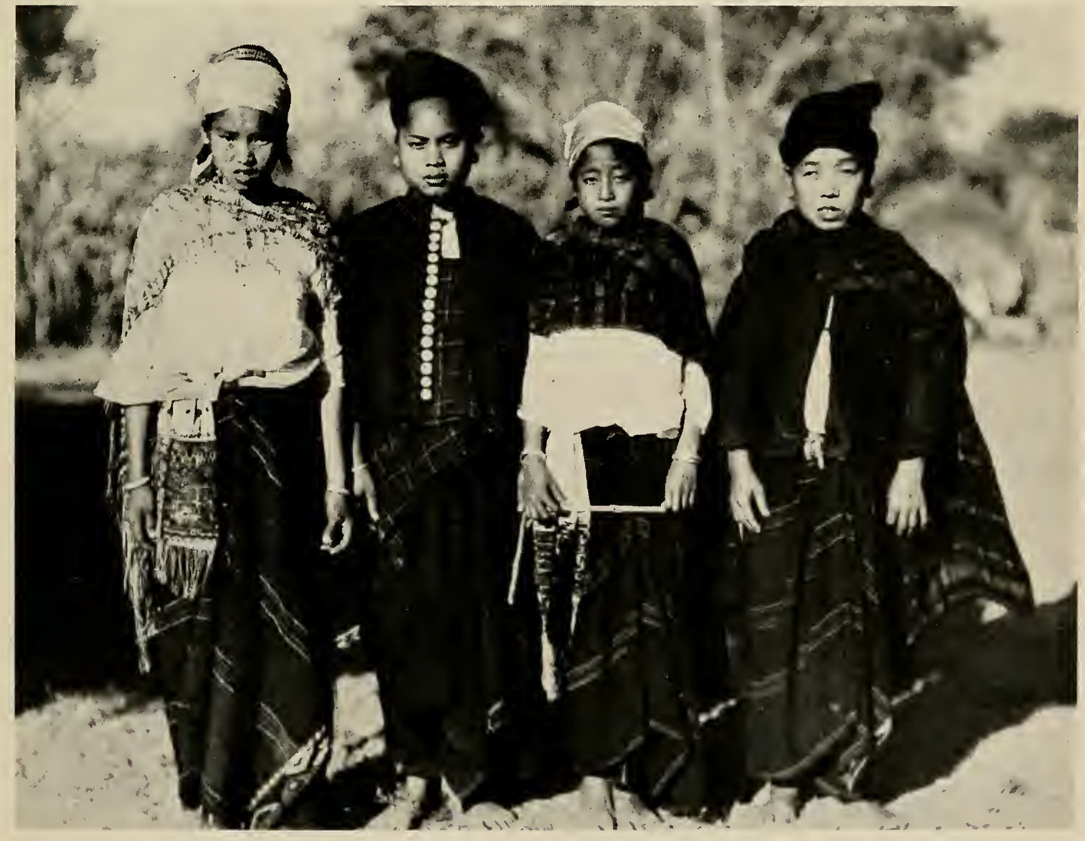
The smile of friendship was bestowed upon the white men. Although the Kachins are fierce toward their enemies, they received the Expedition with cheerful hospitality

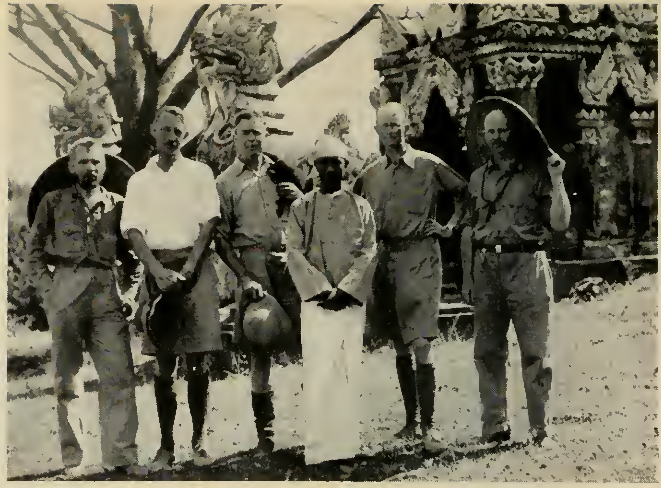




(Above) A Kachin boy. The Kachins live by agriculture and hunting. Cultivation of rice without irrigation is one of their chief pursuits

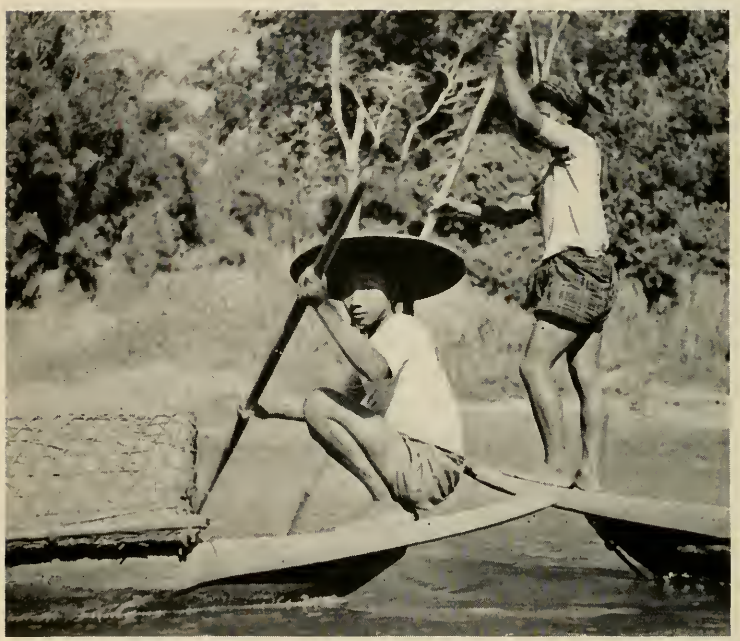
The ear-plugs worn by the girl at the right are bars of amber, which is mined locally. Plaster casts were taken by the Expedition of these and other native types



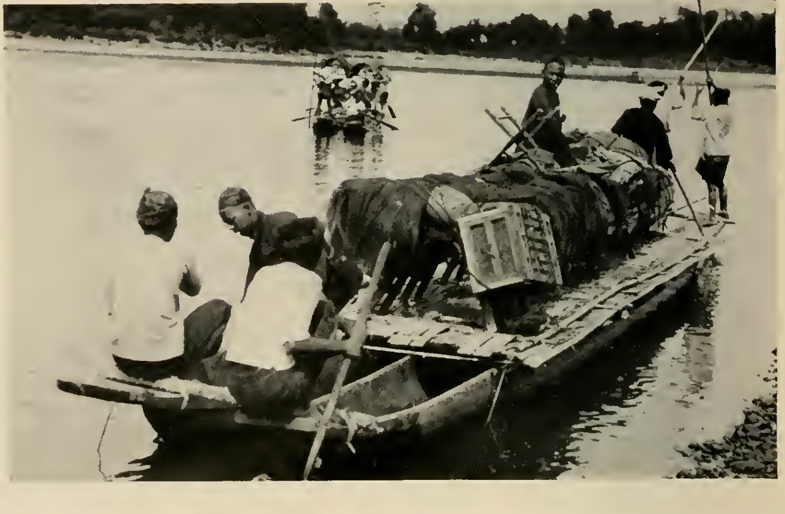


The Vernay-Hopwood Expedition, with the chief who escorted them to a village of the head-hunting Nagas. Left to right: Charles McCann, G. S. Rowley, Arthur Vernay, Sawbwa of Singkaling Hkamti, R. C. Morris, H. C. Raven

River Travel



Native dugouts facilitate transportation in the dense jungles of northern Burma



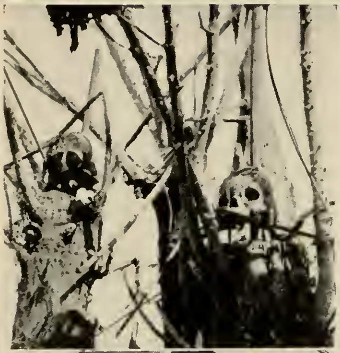
The Expedition is ferried across the Chindwin. The many mules had to swim here, while their pack saddles were transported on native barges

Mule Pack

The transportation unit comprised 110 mules and 22 Yunnanese muleteers. Interpreters, skinners, and cooks rounded out a personnel of 52 assisting the 6 white men

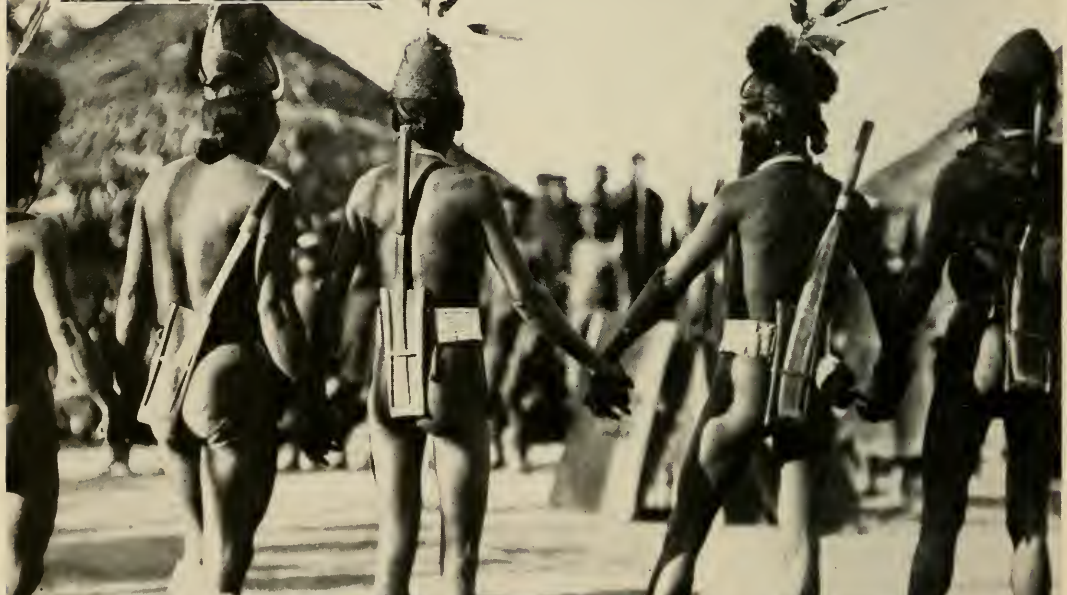
In breaking camp, each of the muleteers would give out a curious call and his five mules would come to hand and be saddled

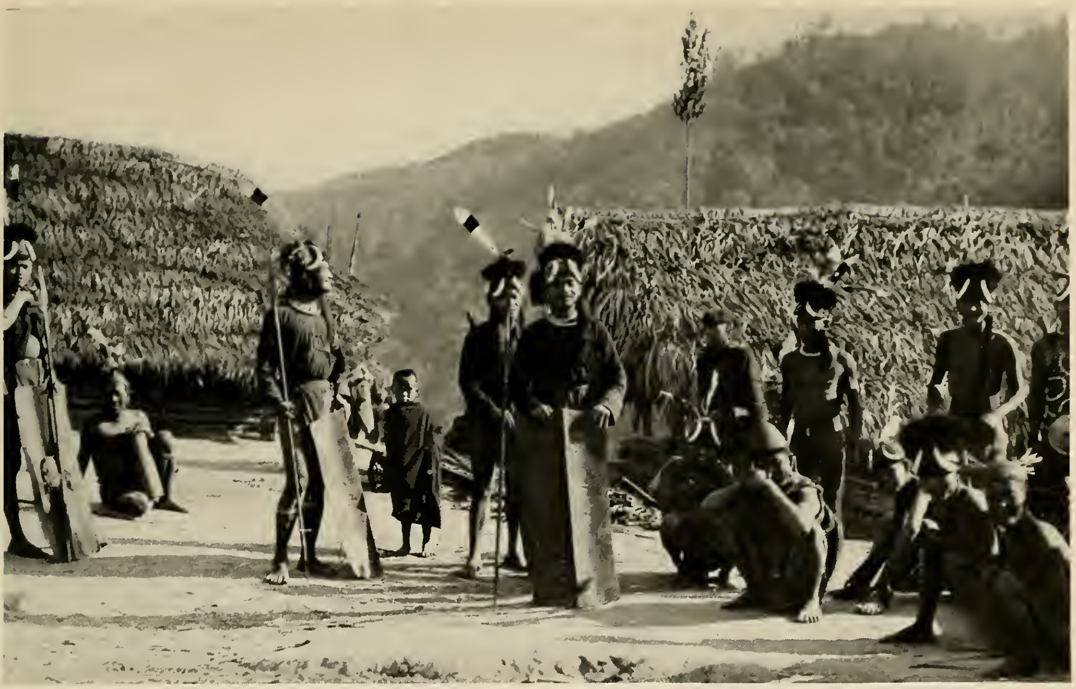
A village of the head-hunting Nagas



(*Left*) *Heads which had been taken within a few months of the Expedition's visit*

(*Below*) *The dance of the head-hunters*



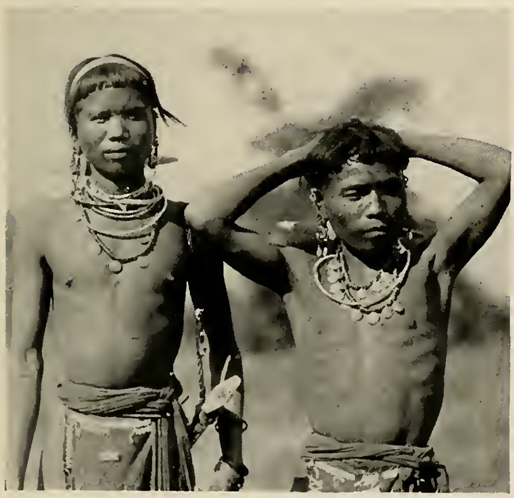


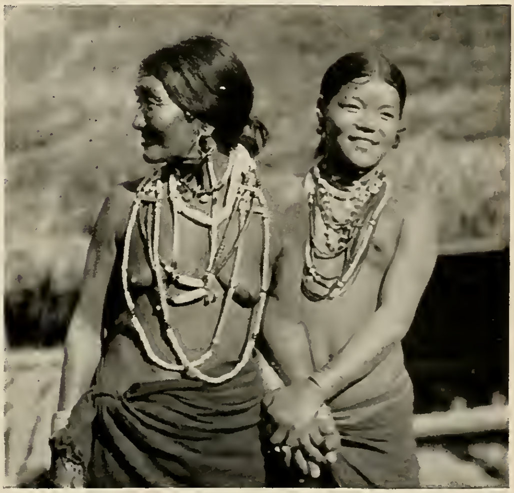
The dancers wore headdresses decorated with boars' tusks, feathers, and goats' hair dyed red

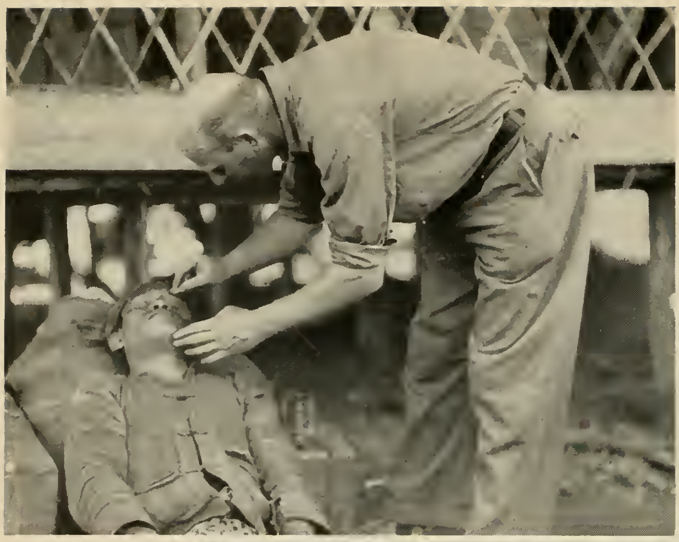
(Right) Drumming an accompaniment on a hollowed tree trunk

(Below) Ornaments are more important than clothing. The bone through the back of the men's hair is from the rib of the water buffalo

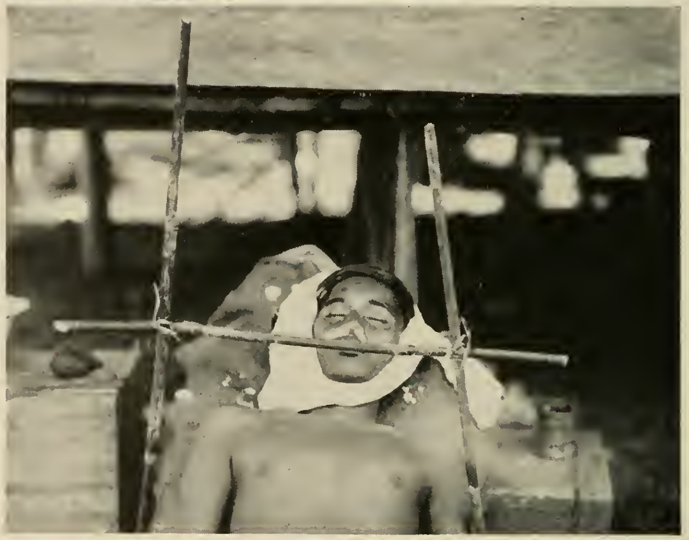
Nagas—Head-Hunters

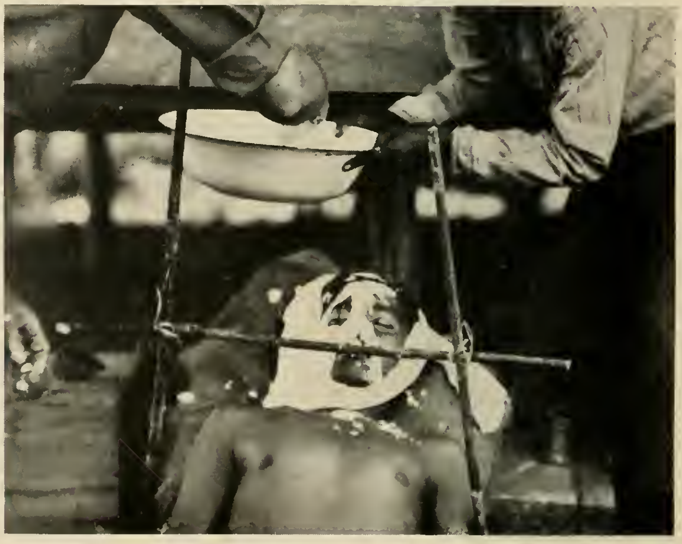






The scientists "took heads" in a different manner. Permission to make plaster casts of the various tribal types was difficult owing to superstitious fears. Patient persuasion and the gift of a rupee were necessary





Breathing through the glass tubes inserted into the nostrils as shown in the center picture is not easy. The plaster hardens in about twenty minutes, and when the operation is finished, the victim blinks and declares the bribe well earned

Winged Monarchs of the Air

Birds used in falconry, an ancient pastime worthy of a place in the field sports of today

By George G. Goodwin
Assistant Curator, Department of Mammalogy, American Museum

When the old eastern travelers, Marco Polo and Father Rubruquis, explored the little-known regions of Asia during the Thirteenth Century, they found falconry practised by the wandering tribes of Tartars. Marco mentions a palace at Chang-nor where the "Grand Khan" says the old Venetian "derives the highest degree of amusement from sporting with his falcons and hawks." The Grand Khan, Kublai at that time, who was Emperor of Tartary and China, had two court officers of the highest rank called "Masters of the Chase." Marco Polo was a keen sportsman and falconer himself and apparently often accompanied the Grand Khan, or Emperor, with whom he stood in high favor, on his hawking expeditions, attended by the incredible number of ten thousand falconers. The old Venetian lets us into the interesting secret that even in those days strict game and forest laws were rigorously enforced in China and Tartary.

Falconry in history

Falconry played an important part in the early history of Persia and India, and in later years all Europe was enthusiastic about the sport. It was preëminently the national sport in England at the time of the Crusades and has done more to make the English-speaking people a race of true sportsmen than all the rest of our pastimes put together. While a revival of falconry to the old standard would mean the restoration of a state of things that is past and cannot return, there is no reason why it should not take a place in the field sports of today where the country is suitable and game is found.

In recent years various attempts have been made to establish falconry in America, but the sport is a costly one; game in suitable localities in the East is scarce, and results more often than not have been both unsatisfactory and disappointing as compared with its success in England. Falconry has much to recommend it, especially in this age. It is surrounded by many distinguished associations, and is in itself so fine and picturesque a sport that attempts to introduce it here will in time, I hope, prove successful. Contrary to the general belief, the practice of this sport is not apt to drive game away from the region where falcons are used, and it is humane to the last degree. The quarry is either killed outright or goes scot-free; and there are no crippled birds to crawl away and die by degrees.

Types of hawks

The training of hawks and falcons, though easy enough to practice when once learned, is one of those arts which cannot be readily gained from a description in a book. During the last few years I have had a rapidly increasing number of requests for information on falconry, which has induced me to give a few hints and a very brief outline on the management of hawks.

There are two very different types of hawk to be had in America which are suitable for this sport, and the training and nature of each is widely different.

First are the long-winged, high-flying falcons, which include the duck hawk or noble peregrine falcon, prairie falcon, pigeon hawk or merlin, generally known as the ladies' hawk, and the northern species of stately gyrfalcons. These, with the exception, to a degree, of the pigeon hawk, can be flown satisfactorily only in open country.

Secondly come the short-winged, fast, low-flying hawks, which include the gay goshawk, Cooper's hawk, and sharp-shinned hawk, and can be used in enclosed and forested country. In a class by itself should be included the golden eagle, though as a falconer I would not recommend an eagle except as a possible experiment or in open desert country where jack rabbits are abundant or a possible fox can be found in the open. All other American hawks are really, for all practical purposes, unsuitable for this sport, although a beginner at first can do no better than practice on a red-tailed hawk or a red-shouldered hawk. They can, when in good condition, and with a fair chance, catch a rabbit.

Early training

The process of training falcons has been discussed by numerous authors in many books and in various languages, all of which are today out of print and difficult to obtain. The Hollander catches his hawks when in passage or migration and these are termed passage falcons; while the Scotchman takes his from the nest, and his are called eyess falcons. The objective, however, in either case is the same, and that is to teach the hawk to be obedient.

The eyess, or young hawk, taken from the nest, though much easier to train than the haggard or wild-caught falcon, lacks the dash and style of the latter. To overcome this drawback, the falconer puts his young hawks out to hack — that is, they are put in an open basket on a roof or the stump of an old tree, fed with fresh meat tied securely on an elevated board, and left entirely alone. The wilder they get, the better hawks they make when trained. Young hawks, when properly handled, will learn to fly and stoop in a remarkably short time, making long flights into the neighboring country, but returning at regular intervals to feed. For fully three weeks the young hawks must have freedom, but as soon as they kill for themselves, which usually occurs the third week after they can fly, in the case of the tiercels or males, they must be taken in. The falcons, the name usually applied to the females, being larger birds, take longer to mature, and can be left out for a greater period of time. Taking the young hawks in from hack will need a certain amount of skill and a bow net.

Care should be exercised when the young birds are taken from the eyrie that they are at the proper age, having attained all their feathers, and with only a little or no down left. The longer they can stay in the nest, the better. At least half of the brood should be left to ensure a similar breeding place near by the following year. Occasions arise, however, when the young hawks to be taken care of are far below the desired age. These should be put in a clean box with a wire screen on one side facing an airy but sunny window. The box should be about three feet long, two wide, and two deep. The young hawks must be fed every two hours from daybreak until dark through a curtain at the back of the box. A long pair of forceps may be used, if necessary, to hand-feed them, but under no circumstances must the young hawks be permitted to see the hand that feeds them or suspect the origin of their meals. Freshly killed poultry, pigeons, birds, and rabbits may be used, and small feathers or fur and crushed bone included in their diet. It is interesting to note that lack of food during any period of the growing stage in young hawks will result in hunger traces or white lines across the wing and tail feathers. This not only weakens the feathers so that they snap under pressure, but results in a useless hawk.

"*Manning*"

The real training of the hawk, or manning, as it is technically termed, starts when the eyess is taken in from hack or at the time of the migrant's capture. First a soft leather hood is put over the hawk's head, covering the eyes, and a pair of jesses — short strips of leather — are fastened around the legs just above the foot. The jesses are joined together on a swivel which in turn is attached to a leash and tied to a block. To keep the falconer in constant touch with his bird, a bell is fastened on each foot just above the jesses. In this way one can know exactly what the hawk is doing from the sound of the bells, and in the case of a lost hawk, they are of infinite value, for as the hawk moves, the tinkle of the bell can be distinctly heard for more than a quarter of a mile. The best bells are now made in India, but European bells, though of a different shape, answer the purpose very well.

The hawk, equipped with all the necessary trappings, is now ready for the delicate business of training. It will be well here for the beginner to resolve to keep before him the two major maxims of the falconer, "Gentleness" and "Patience," because he must have the former and he will need plenty of the latter. The hawk is carried on a gloved hand for as many hours as is reasonably possible each day. Carrying is the most important factor in training, but it must be done in such a way as to gain the complete confidence of the bird. Hawks are among the wildest and shyest of birds in existence, and at first require unlimited patience. Haggards, or wild caught adult hawks, especially of the short-winged group, should be carried for twenty-four hours for the first few days and gently stroked and spoken to. Young hawks will do with much less carrying, about six or seven hours a day. The feeding is first done through the hood. Later the hood is removed by candlelight while the hawk is feeding and replaced before the end of the meal. In this way the hawk does not associate the hood with the end of the meal and resent it. When the hawk gradually has become used to people by artificial light, it is fed unhooded in daylight, and the hood is replaced before the end of the meal.

The hood

The use of the hood is a little misunderstood. The hawk is not kept blindfolded nearly all the time but, on the contrary, when trained, is hooded only when there is a possibility of its being unnecessarily disturbed, or to keep it quiet until the right moment when approaching game.

After a week of constant carrying, a young hawk will look forward with apparent pleasure to the daily walks, and will unhesitatingly jump on the trainer's fist and look for the scrap of lean meat that should always be found there.

If it is a falcon that is being trained, the lure is next brought into use. This is the most important factor in the falconer's equipment. It consists of a padded weight covered with leather and with the wings of a pigeon attached to either side. It is provided with strings for the attachment of meat and a long string by which to swing it. The weight in the lure must be discarded when the hawk has been trained, for by then it has been taught not to follow its natural inclination to carry its victim away. Should the hawk strike a weighted lure while in free flight, it would kill itself.

The feeding is now transferred from the fist to the lure and after a few lessons the falcon goes immediately to the lure for food. The distance it has to fly is increased day by day, first with a line attached to the jesses, until it will come a distance of fifty yards or more. The hawk should start the instant the lure is shown and be on the way by the time it hits the ground. Frequently, if in condition, it will follow up before the required distance can be reached.

A critical stage

It is now ready to fly loose, but the distance at first should be shortened to half and then gradually extended each time the hawk is flown. When the hawk will come unhesitatingly two hundred yards, step in between the hawk and the lure and remain perfectly still, as this is a critical time. If all goes well, the young hawk, being somewhat clumsy on the wing, will not be able to make a quick turn, but will swing to one side and mount in the air and wing around for a second attempt at the lure. This time it is rewarded. After several repetitions of this, the falcon is kept on the wing, or "waiting on" as it is called, for several minutes, by concealing the lure. This exercise is increased daily for a time, and then the falcon can be entered.

An easy bird of the particular quarry that the hawk is to pursue is put out in a small cover in an open field and sprung when the hawk is overhead. If a crow is used, the falconer places a freshly killed pigeon under the black wing of the crow before the hawk has a chance to taste the unpalatable flesh of the crow. The error is often made of entering the hawk to a pigeon thrown out of the hand. An eyess will faithfully follow the game at which it is entered, and there is no surer way of losing a valuable game hawk than having it check off after some stray pigeon half a mile or more away. Throwing the pigeon out of the hand also gives the "show away" and the hawk will always expect a repetition and will pass up the wild game.

No attempt should be made to fly a hawk in the rain or high wind. When hawking, always approach the quarry up wind and fly the hawk into the wind to help her mount. A falcon, on attaining her pitch, almost invariably works down wind. Take care that in that direction there is no such obstacle as a large wood where the quarry can hide, or a sheet of water or river which you cannot cross.

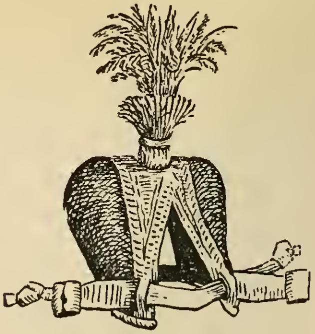
On preparing to "hood off" at the quarry, the falconer, having approached up wind, must be ready to slip the hawk at a moment's notice. The leash and swivel are detached from the jesses, which must be held securely between thumb and forefinger, and the braces of the hood are half drawn to admit its removal by the plume the instant the quarry rises, care being exercised not to release the hawk before the hood is removed. At the whirr of wings the hawk is off, trusting to you to remove the hood.

As to the distance at which a young hawk may be slipped, that will depend entirely upon circumstances. A young and inexperienced hawk should have short slips to start with, say sixty or seventy yards at most. It is astonishing what a distance a good hawk will go up to her quarry when she has had a few good flights. In England it is not unusual to slip a falcon after rooks more than a quarter of a mile away.

Game hawking is usually practised with dogs which point the bird; the falcon "waits on" overhead. The higher the pitch the better. If it is a pheasant that is sprung, the falcon, stooping downward, knocks it headlong to the ground. In this case, however, an effort is made to send the quarry down wind instead of against it, enabling the falcon to make her stoop. Pheasants, Scotch grouse, and other fast-flying game birds with short wings and heavy bodies have a knack of cutting through the wind like cannon balls, whereas the falcon is slightly harassed therein by reason of her longer body, wings, and tail — termed by the falconer her train.

Short-winged hawk

The goshawk and other short-winged hawks are trained in the beginning in much the same way as are the falcons, except that they are flown to the fist and not the lure. They need more carrying than the falcons but will suffice with less exercise. They are flown directly from the fist at the quarry and the flights are relatively short and quick. While less spectacular in flight than the falcons, they can be flown in forested country, are extremely plucky birds, and are rarely disheartened by unsuccessful flights.



A Dutch Hood

The hood protects the hawk from being startled by seeing unfamiliar faces and objects while it is undergoing training. After the training is completed, the hood is used to prevent the bird from starting off after undesirable game

All hawks must be weathered a few hours each day before flown, that is, they must be put out on blocks or perches on the lawn or in the orchard, where there are no horses or cattle. A bath should be given about three times a week and every day during hot weather from 9 to 11 A.M., and should be put down and filled before the hawk is carried out, so as not to alarm the bird unnecessarily. A zinc tray about three feet square and four inches deep makes a capital bath, and a hawk will go freely into it, stooping down, extending its wings and tail, and throwing the water up over its back in evident enjoyment.

When feeding a peregrine, goshawk, or Cooper's hawk, the meat should be fresh, lean beef; for a pigeon hawk or a sharp-shinned hawk, sheep's heart. The latter is more easily digested than beef and is the nearest approach in butcher's meat to natural food, namely the flesh of birds. It will not do, however, to feed them on this daily without a change. About every third day a peregrine should have a pigeon, the leg of a fowl, or a rabbit with the fur. A pigeon hawk should have small birds or mice. The latter, to be kept in good condition, should be fed twice a day. The early meal, if light, will not interfere with their flying in the later afternoon. A peregrine needs to be fed only once a day and that about five, unless it is an eyess, in which case it should be fed twice a day or even oftener for young and growing hawks. A peregrine will take about seven or eight ounces at a meal, smaller hawks much less. Hawks must not be fed or flown until they have cast. Fur and feathers are not digested but thrown up in the form of a pellet, usually sometime before noon the following day. These should be fairly dry, compact, and evenly rounded. Loose, wet castings indicate a poor condition of the hawk, and freshly killed poultry or pigeons should be fed while still warm with plenty of small feathers until the castings appear normal.

Obtaining hawks

Frequently I am asked where a pair of falcons can be obtained. It is generally known by those interested in birds that hawks do not breed in captivity. In this country there are no professional hawk trappers and one must depend on his own ingenuity to secure birds. Falcons breed on almost inaccessible high cliffs and are fairly plentiful on both coasts. A falconer usually prefers to obtain his own hawk, or they must come into his possession soon after taken in captivity. Cooper's hawks and sharp-shinned hawks are not uncommon in wooded localities within fifty miles of New York. Goshawks are northern birds and rarely breed south of Canada, but periodically visit the States during winter migrations.

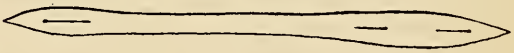
The reader will doubtless find an account of the actual practice of falconry more amusing if not more interesting than the dryer details of training.

In Great Britain hawking, like shooting and fishing, has its proper seasons. In the early spring, the long-winged hawks are flown at rooks, crows, and magpies. When the twelfth of August comes around, these same hawks are through the molt and ready for the Scotch moors, where the falconer sees the remarkable sight of his hawk stooping downward from a great height at a fast-flying grouse and knocking it headlong into the heather. This has to be seen to be believed. In September, these same hawks will be ready to make short work of the partridge.

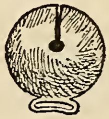
An idea of an actual flight can be gotten from the following excerpt from the classic work of Major C. H. Fisher, *Reminiscences of a Falconer*, which describes how his falcon "Taillie" killed a full-feathered woodcock after a splendid flight:

"I may here mention a singular flight I once witnessed at a woodcock. This bird, when put to it, possesses remarkable powers of flight, as its extended migrations, and splendid shape and length of wing, abundantly warrant. It occurred in this wise. In October, 1866, I found myself with hawks (eyesses), dogs, gillies, a keeper, and my gun, on the moor near the western end of Loch Eil, in Argyllshire, at a place called Fassiefern, not far from the place where Prince Charlie met his devoted Highland clansmen in arms for his crown, only to lose the day and their lives at fatal and bloody Culloden. I made a line to beat out a wide bank of bracken, then brown with early autumn, and saw a bird which I believed then to be a cock, and the keeper, a winged grouse, jump up in front.

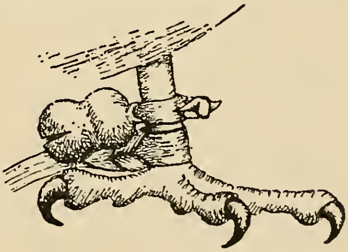
"Had I but had the courage of my convictions, and put my favourite falcon, called 'Taillie,' from her broken tail — a Welsh hawk she, from the Glamorgan precipices of the Worms' Head — aloft, then she would probably have been saved much trouble, and we should have lost a glorious sight, and flight, for the day was stilly, bright, and lovely, and the sea-loch and its waves sparkled in the sun. No, I took her on my fist, and struck her hood in readiness, half disposed to believe in McPhee the gamekeeper. Just where I saw the bird spring, suddenly up went a fine woodcock. No winged bird she, but in full possession of the excellent pair that had not long before brought her (I



The jesse or strip of soft leather is fastened round the hawk's leg to tether it



Bells betray the whereabouts of the trained hawk. The European bell is illustrated above



FOOT EQUIPMENT

Sketch showing how the jesse and the bell are attached to the hawk's foot. The Indian bell shown here is preferred by most falconers suppose, for we do not know) from Finland, or elsewhere in the north of Argyll, I unhooded and cast 'Taillie' after her, and the flight began. This woodcock would have much astonished sportsmen only used to their actions in a thick covert. Up and up she went in long zigzags, with precisely the style and action of her small relative, the common snipe, but mute.

"The falcon mounted rapidly in her train, though at a considerable disadvantage at first. I saw it was going to be a long affair, got out my glasses, and lay down on the heather, and on one side was my then falconer, Jamie Barr, one of the well-known family of Scotch falconers. There were once a father and three sons of that name (all falconers by profession), with most acute and trained vision, and on the other side the proud possessor of the best pair of eyes in all Argyll, if not in the West of Scotland — the so-called 'fox-hunter's' son, my gillie, Sandy Kennedy. This man got much employment in seeking sheep lost on the hills and mountains, and long practice had rendered his ancestral eyesight (his father's had been as good) equal to most glasses on the moor.

Warfare in the air

"The woodcock, with the falcon below and behind her, did not dare to come down or return — *vestigia nulla retrorsum* was her motto — and soon the pair of dots were high over the sea-loch, there a mile wide, the cock's point being evidently Morven, on the other side of the strait. Soon I called out, 'I can see but one.' Presently from Barr came, 'I canna see them;' from Kennedy, 'I ken 'em fine!' I hardly believed he could, for my own eyes were then far above the average, and, aided by the best of Voigtlander's field-glasses, it was as much as I could do. Presently methought that the single dot in the sky which I still discerned became, instead of fainter, faintly more visible.

"'They are coming back,' quoth Kennedy, and before long the spot had visibly increased, and the falconer Barr declared that he saw them once more. So did I, and so did all before long; for the woodcock, finding herself over the water, and unable to shake off her pursuer or gain the distant haven of Morven, had no alternative but to seek the shelter of the bracken on our side, from whence she sprang; so the poor fowl turned tail and 'went for it' in a long slanting descent from an incredible altitude.

"As they both neared us they presented the appearance of two little balls falling out of the sky right toward us, and quite straight, with the difference (fatal to the poor woodcock) that 'Taillie,' who began below her, was now well above. The hawk was evidently unwilling or afraid to stoop over the water, but the moment the cock was over the land, she shot herself forward, and straight in the air, instead of slanting, half perpendicularly down, like her quarry (both moving with incredible speed), turned over, and stooped.

The speed of the falcon

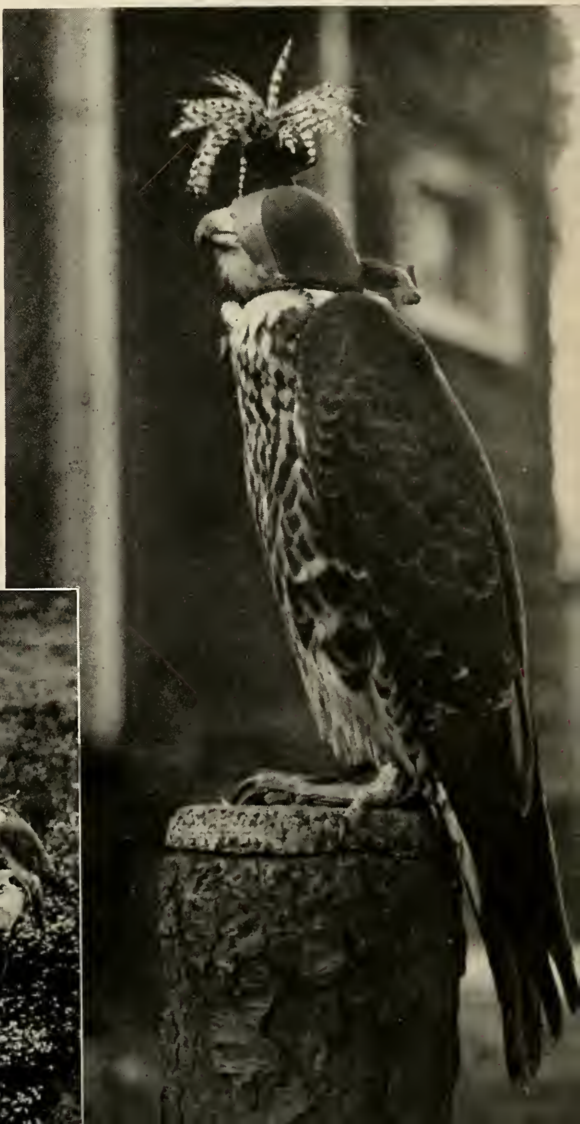
"No one knows the speed of a falcon's stoop, but it must be very great, as I have seen it bring a hawk up to old grouse flying hard down wind, just as though they had been sitting still, with absurd ease, if only she be but high enough. Anyhow, it was fatal this time to the woodcock, for, leaving a cloud of feathers behind, she tumbled head over heels before us into the very patch of bracken she came from, and meeting there with an old anthill, bounded off it many a yard and lay still. The hawk soon recovered herself, and dashed on to her well-earned quarry. Needless to say I did not disturb her thereon, but served out the whiskey, and we drank her health all round. Then we too set to work at our lunch, and when this very tame pet hawk had nearly done hers, I went up to her and took her up, and having replaced the swivel in her jesses and the leash in her swivel, and cleaned her feet and wiped her beak and kissed her, I fastened her to a stone in a lonely burn close by, and witnessed her bathe and dry herself in the sun, preening her feathers to her and our entire satisfaction, and I trust to the satisfaction of the readers of my tale."

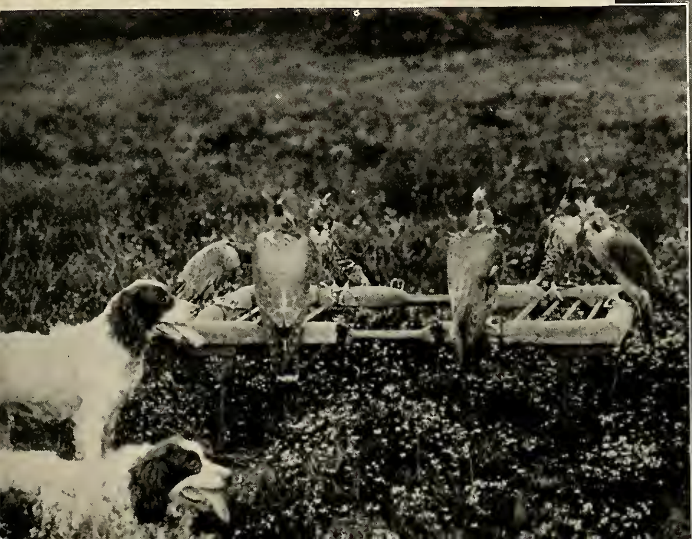
Capt. C. W. R. Knight and his famous golden eagle pose for the camera man. The Kirghez and many wandering tribesmen of Middle Asia have used eagles as a means of livelihood through the centuries.

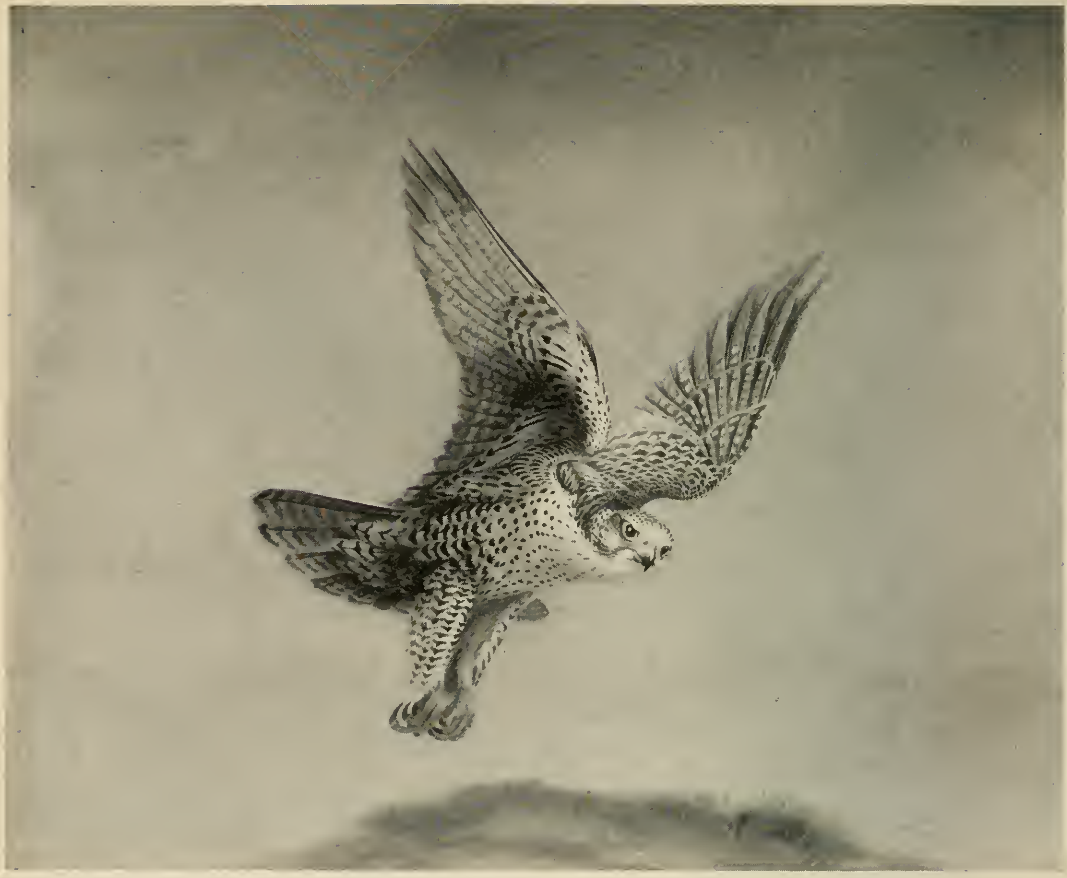
(Right) A peregrine falcon on its block. The falcons are cliff dwellers and rest most comfortably when perched on a flat surface. The falconer provides a block of wood 6 inches in diameter and 10 inches high; a 12-inch spike in one end holds it in position, and there is a steel ring round the spike to which to fasten the leash; the top of the block is covered with a thick piece of cork

(Below) The falconer's cadge (one style of which is shown here) is a device on which a number of hooded hawks can be carried in the field. Individual hawks are flown in turn as required.

Brown Bros.





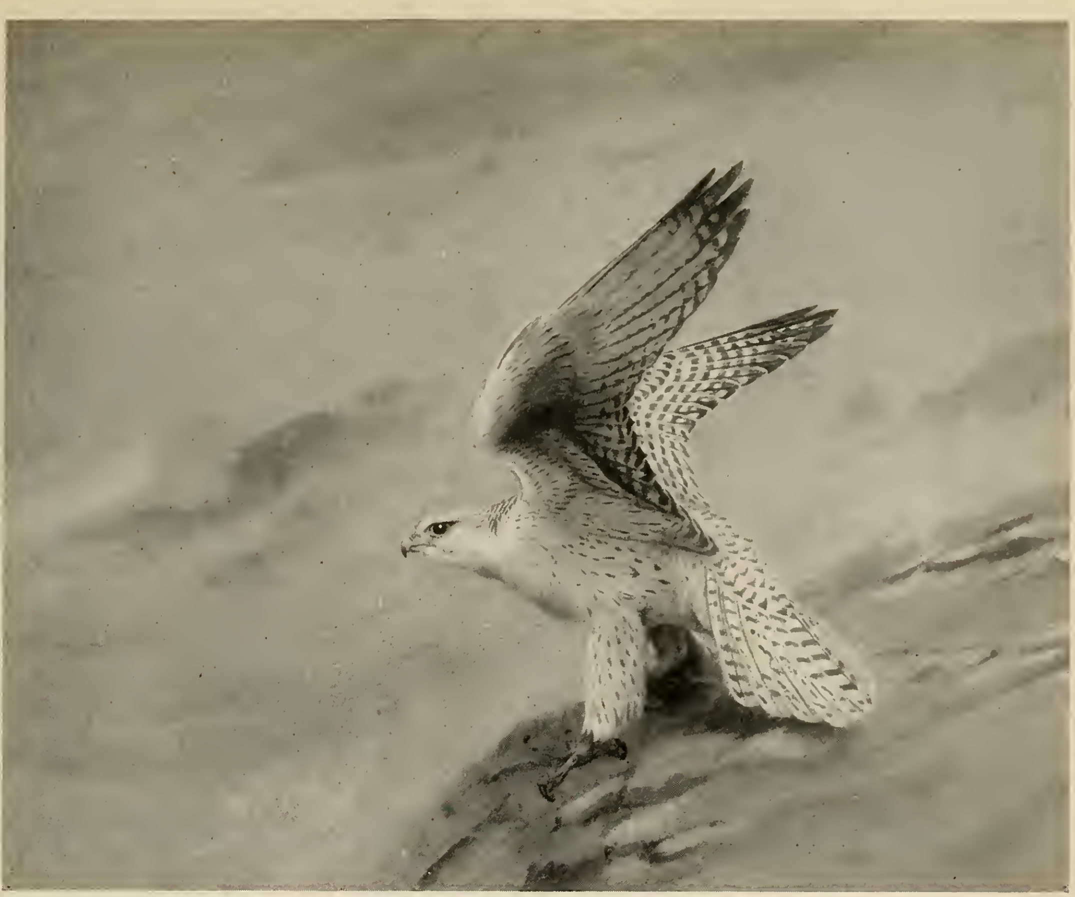


(Above) An Iceland gyrfalcon. From a painting by G. E. Lodge. Modern falconers seem unable to adapt this splendid northern gyr to present conditions. It was so highly esteemed in the Fourteenth Century that it was considered a kingly gift, and often employed when the good will of a potentate was especially desired

The nest and young of the red-shoulder hawk are shown below at the left. A peculiar habit practiced by many hawks is the decorating of the nest with evergreen branches.

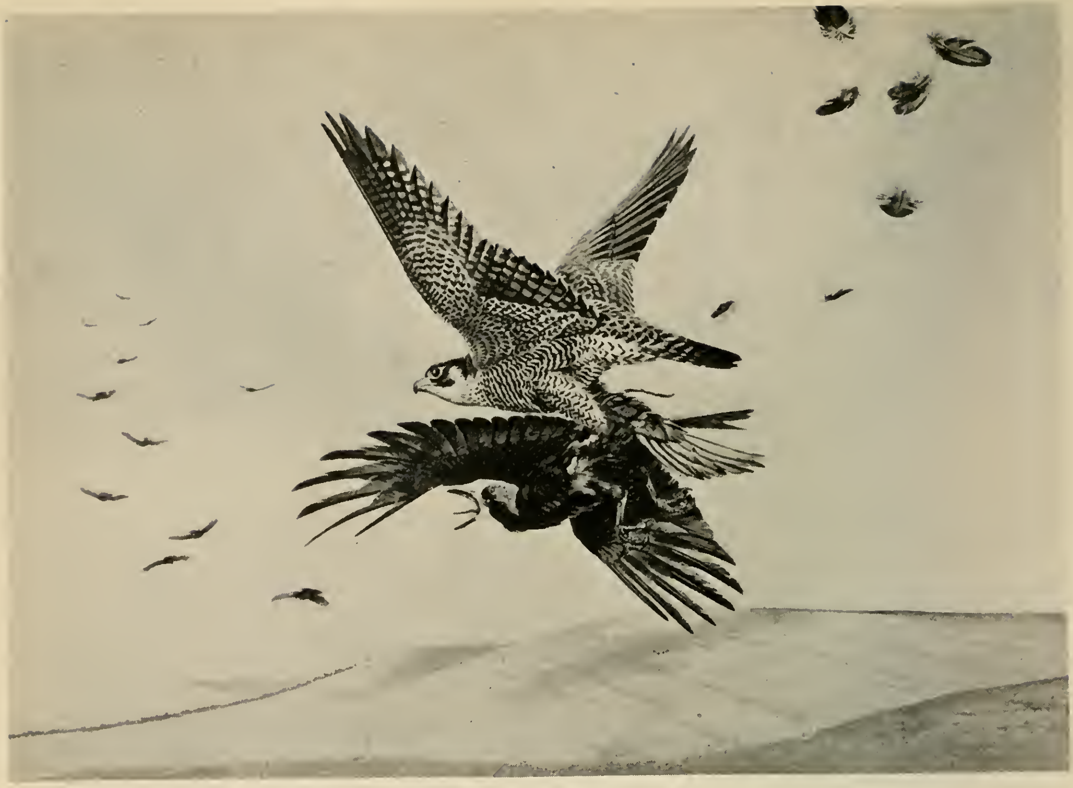
At the lower right is an eyess falcon. Normally these falcons prefer to rest on cliffs and similar open spaces, but in enclosed country the broad limbs of a big tree may be used

Brown Bros.



(Above) The Greenland gyrfalcon, painted by G. E. Lodge. It was probably more highly valued in the Middle Ages than any other living creature. The late Lord Lilford, who in modern times had a good deal of experience with this gyr, opined that it was an excellent flier and stooper but is not hardy and is difficult to keep in condition

(Below) A stud of American game hawks at Cedarhurst, L. I. The process of "manning" hawks or getting them accustomed to the society of men requires great patience and care; when used to people, they must be placed out in the open several hours daily to be "weathered." The falcons are put on blocks, and the short-winged hawks on bow perches

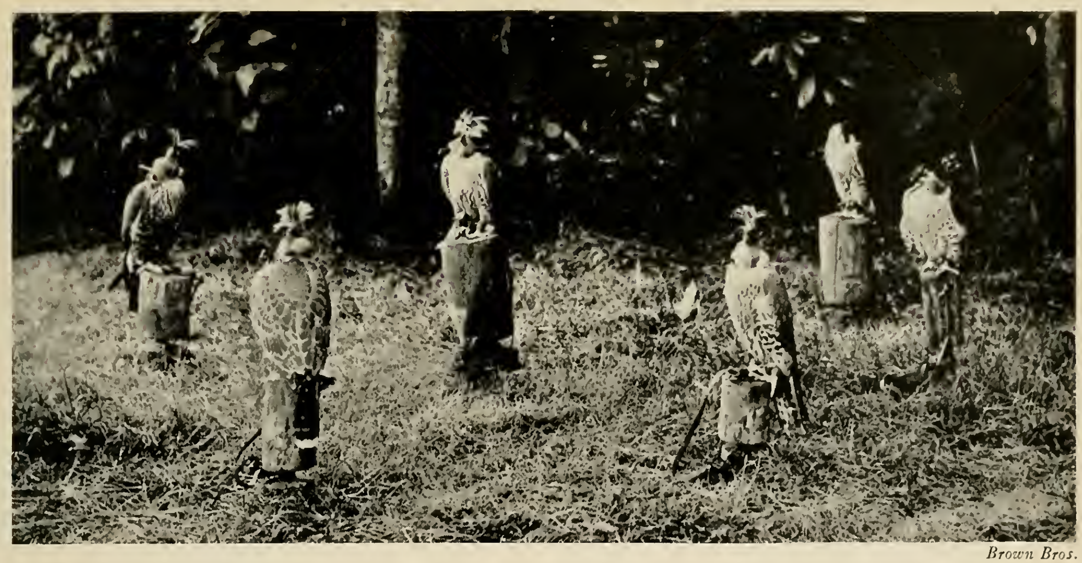


The death of the rook. From a painting by G. E. Lodge. Only in recent years has the rook been pressed into service as a quarry for the falcon.

This is one of the most thrilling uses of the peregrine. The chase often continues for many miles. A good rook will mount and ring up in spiral curves into the very clouds almost as fast as a falcon, and then make off down wind

(Below, left) Mr. W. J. Goodwin and his tiercel. The falcon is carried hooded until the game is located, then the hood is doffed, the leash and swivel removed, and the falcon cast off

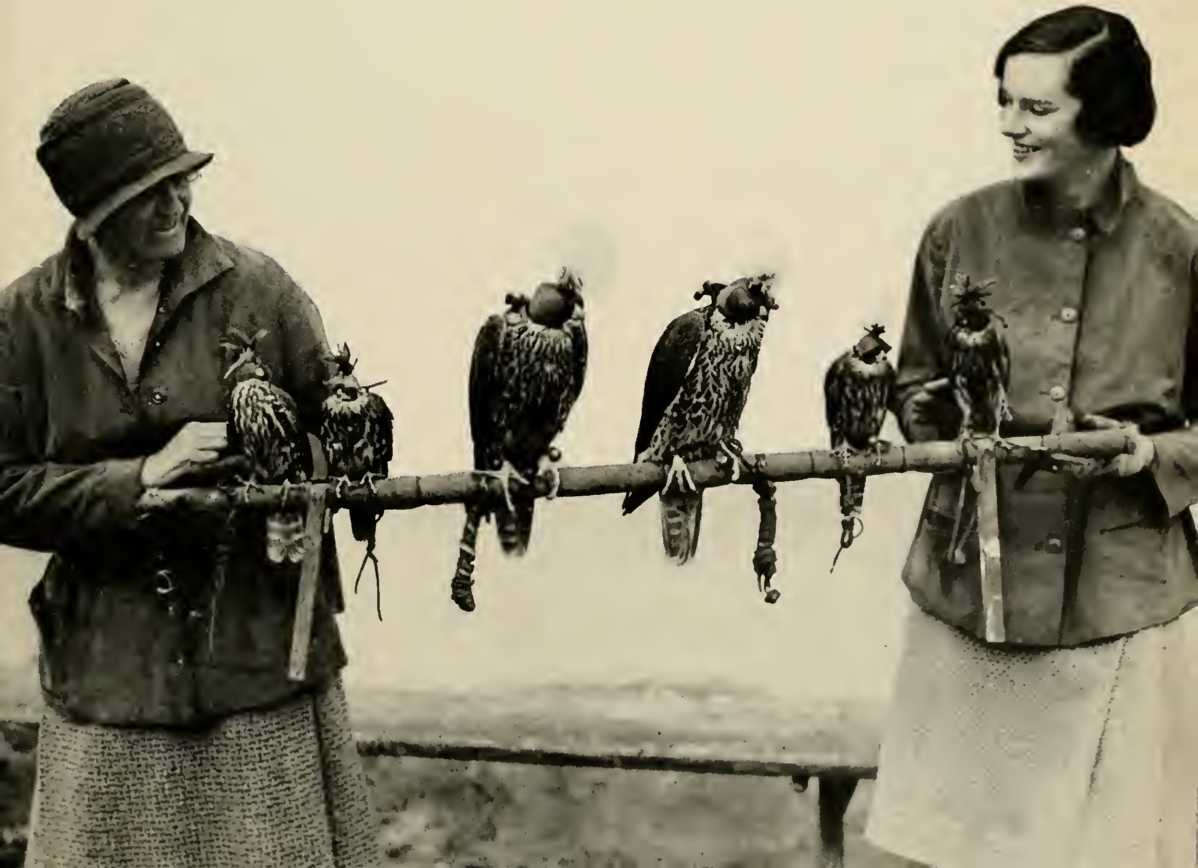
(Below, right) Unlike the true falcons, this European goshawk hunts ground quarry and kills by the vice-like grip of its piercing talons. The hood is not used on this hawk when looking for game in the field

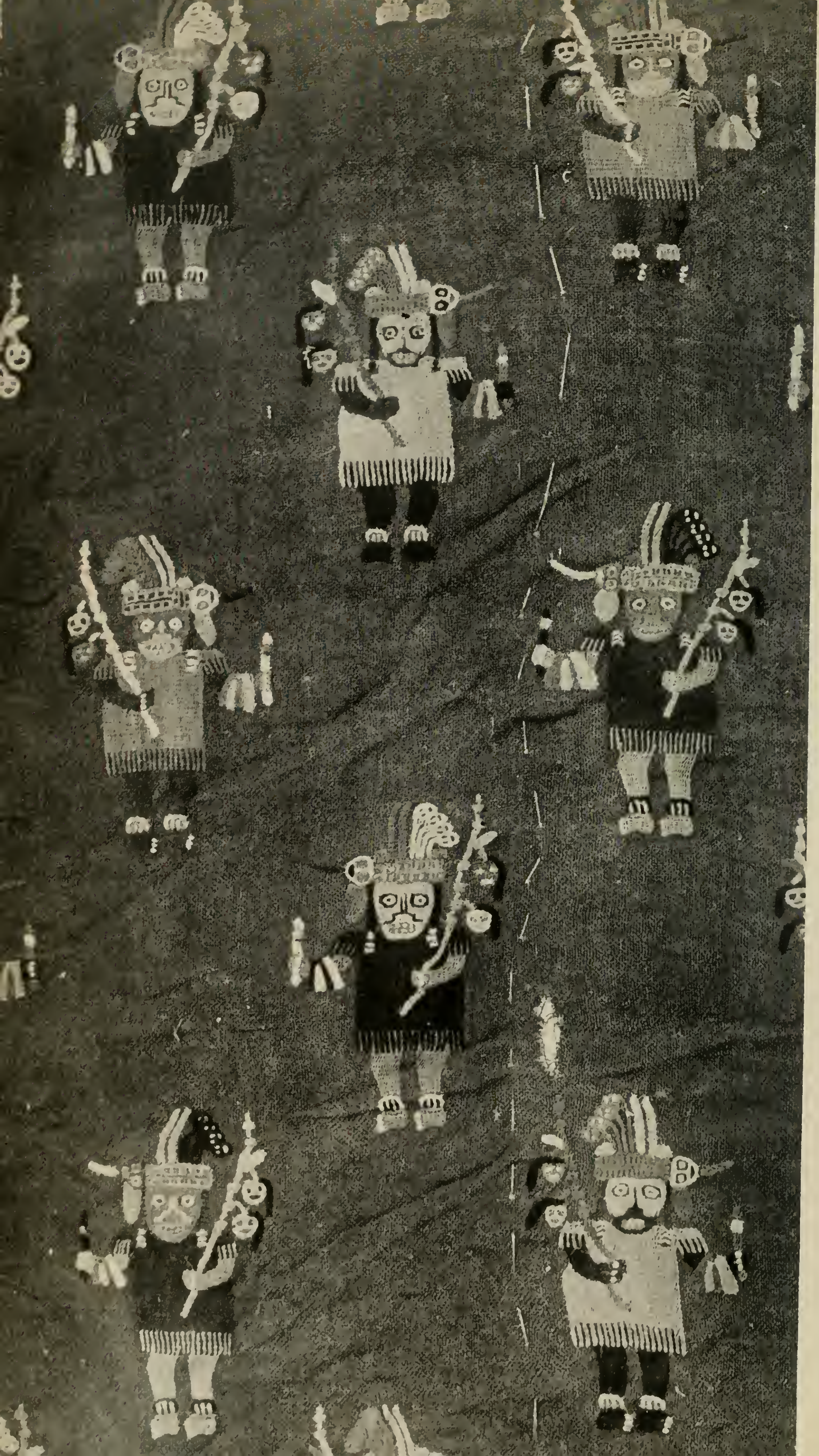


Brown Bros.

(*Above*) *Falcons hooded and ready to be transferred to the cadge. The hawks are hooded a little while before starting for the day's sport, to keep them quiet and conserve their strength. Falcons and hawks should be weathered daily, unhooded, on the block*

(*Below*) *Two peregrines and four merlins hooded and ready for a day's sport on the South Downs, England. The cadge was especially designed by Captain Knight to fit in the back seat of his car when he wished to transport his stud to a distant field*





Weaving in the Land of the Incas

The extraordinary artistic and technical products created in Pre-Spanish Peru

By Wendell C. Bennett

Assistant Curator of Anthropology, American Museum

The Spanish conquerors and colonists who entered Peru during the Sixteenth Century were not met by the traditional naked savage. On the contrary, the accounts of these early settlers and travelers are filled with descriptions of the elaborate costumes of the Inca upper classes.

The men wore beautifully designed cotton and wool ponchos (sleeveless shirts) augmented by a capelike mantle over the shoulders. Four-pointed woven hats, knitted caps, headbands or lacelike nets were used by the men, different styles of headgear designating rank in the society. A narrow loin cloth, sandals, and the inevitable woven carrying-bag completed the costume.

The women were described as wearing a cloth mantle from beneath the shoulders to the knees, secured at the waist with a belt. Additional shawls and a headband completed their costume.

The early writers did not elaborate too much on the variety of the Peruvian weaving, nor could they furnish much information about the pre-Inca periods. However, our knowledge of both these subjects does not depend upon the eyewitnesses. Fortunately, the dry desert coast of Peru has furnished evidence by preserving the most delicate samples of this weaving, even through the hundreds of years that have passed since the early periods of the Peruvian civilizations. Consequently, the specimens themselves reveal the achievements in technique and art of the ancient weavers.

The pre-Inca people of the coast of Peru buried their dead with considerable care. The bodies were tied in a flexed position, knees to the chin, and then wrapped with cloth. The finest shawls and mantles were included as parts of these multiple wrappings.

The bundle was finally covered with a coarser cloth, adorned with a stuffed false head, and perhaps with ceremonial sticks and dolls, and placed in a carefully prepared hollow tomb in the hot sands of the desert country. Logs covered the opening of the tomb and the sand was replaced above it. There in this oven-like situation the bodies dried out into natural mummies, and the cloth wrappings were maintained in an amazingly perfect state.

Highland climatic conditions

The highland section of Peru, in the lofty Andes, is subject to rather extensive rainfall, unfavorable to preservation of cloth. Even the most elaborately prepared tomb could not resist the dampness for many years. About the only large pieces of cloth excavated in the highlands were two Inca ponchos found by Adolph Bandelier more than thirty-five years ago on an island in Lake Titicaca, which lies between Peru and Bolivia on the high plateau. Doctor Bandelier found these two tapestries in a stone box, fitted with a stone cover, which made the preservation possible. Consequently, because of the contrasting geographic conditions, most of the textiles in museums today have been found in association with the coast burials.

The collections of Peruvian cloth have been examined by modern textile authorities (notably by Mr. M. D. C. Crawford for the American Museum's collections) which has resulted in detailed analysis and in unbounded enthusiasm for the skill of the pre-Spanish weavers. Cotton and wool were the basic weaving materials, plus a secondary use of maguey bast-fiber and human hair. The cotton was indigenous on the coast of Peru. The seeds were separated and the fibers

A Peruvian Textile

On the opposite page is a polychrome embroidery showing warrior figures in typical costumes, holding staffs to which trophy heads are attached carded by hand and then arranged in cones, ready for spinning. The wool was obtained from the mountain camel-like animals, the llama, alpaca, and vicuña. The long, silky hair of the wild vicuña was especially prized for spinning the finest thread.

The contrasts in topography between coast and highland were sharp enough to permit sufficient isolation in the various regions for the development of distinct design styles, pottery types, and building techniques. Still, both wool and cotton were used in weaving in all periods of Peruvian prehistory, implying trade, because the cotton was a coast material and the wool came from animals whose habitat was the highlands. Even the earliest coastal textiles have a high percentage of wool thread. However, the trade was probably in raw materials, since the early coast designs show little influence of highland style.

The cotton and wool fibers, having been straightened, were spun into thread by a hand-twisting process aided by slender pointed spindle shafts on which were narrow bands of clay, bone, or metal. The work baskets of the weavers have been found in graves which contain all of the spinning and weaving tools. Besides the spindles, the baskets contain long bobbin shafts with raised carved figures on both ends to keep the thread from sliding off, balls of spun thread, small clay bowls in which one end of the spindle was placed as an aid in twisting, copper needles, and other instruments.

In spite of this elementary spinning process the resulting threads average about two or three times finer than modern machine spun thread from the same materials. Two or more single threads were twisted together to form a stronger yarn before being woven. Two- to seven-ply yarns have been found, but a single-ply was seldom used. Some of the yarns were dyed various colors but many were used in their original hues. Both brown and white cotton were cultivated, and the wool ranged through many shades of brown.

A primitive loom

The loom on which all these textiles were woven was a simple apparatus consisting of two horizontal bars to which the warp threads were attached, either directly or by means of an additional heavy cord. The upper bar was attached to a tree or to stakes, and the lower bar to a girdle which encircled the back of the weaver. Thus the weaver could increase or slacken the tension on the warp threads by leaning forward or backward. This type of "girdle-back" loom is definitely established by the archæological record, as well as by actual specimens. An early Chimú picture vase from Chicama, on the northern coast of Peru, bears a scene of weavers, all of whom are using "girdle-back" looms.

Even in modern times the use of the old type looms has persisted with but minor changes, and one can still see Peruvian Indians weaving, although without the versatility and skill of their ancestors. Finally, a study of textiles made by Miss O'Neale and Doctor Kroeber at the University of California has shown that most Peruvian textiles are less than thirty inches in width, and that wider pieces have either been sewn together, or skillfully loom-joined so that they could be woven on the narrow looms.

The weaving process

Weaving consists of passing weft threads back and forth through sheds formed by separating alternating warps. In the Peruvian loom one shed was formed by a flat stick, or weave sword, which, when turned on edge, separated alternating warps, and the reverse shed was formed by lifting a round stick (heald rod) to which the opposite set of alternating warps was attached by means of a looped cord. This was for weaving plain cloth or solid color band decoration. More complex design, which involved special groupings of warps, was inserted in small sections, the sheds being separated with a short pointed stick or weave dagger. This was the basic technique of all the weaving, although various specialties will be described later.

With this simple spinning and weaving apparatus the Peruvians produced not only quality but quantity of fabrics. Thousands of complete and fragmentary textiles have found their way to museums. How many thousands were destroyed by plunderers hunting for gold, even up to recent years, is unknown. The textiles made in the highlands and buried there have been destroyed by time and weather. Furthermore, it is said that many fine textiles were sacrificed as part of religious ceremonies.

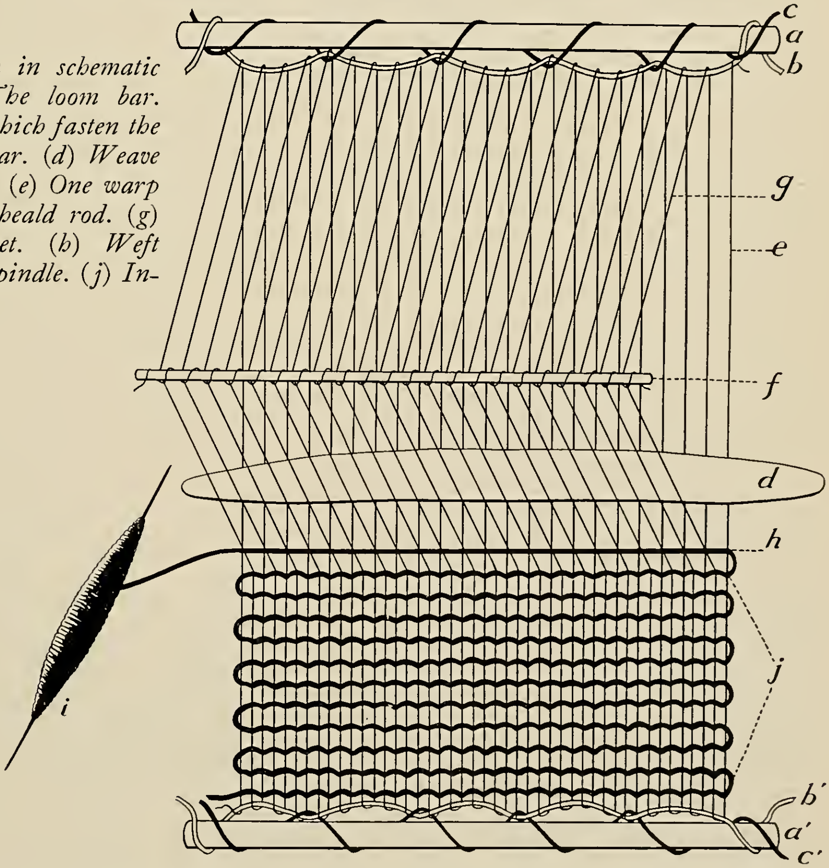
Many of the Peruvian fabrics are classed as plain cloth, that is, loosely beaten up weaves of individual or group combinations of warps and wefts. These fabrics are commonly without decoration or color, except for the natural shade of the yarn. However, some pieces were dyed in solid color. In our admiration for the elaborate designing of some fabrics, the large quantities of plain cloth are apt to be forgotten. Simple stripe ornament is a variant of plain weaving. Stripes of one or more colors were inserted as warp threads before the weaving was started, or wefts of colored yarns were woven in bands on plain warps. The combination of both warp and weft stripes produced a checkered pattern known as gingham.

Plain cloth formed the basis for several types of designing. For example, designs were painted on a plain cloth surface, either free hand, or with stencils and stamps. Or a plain cloth was bunched and tied with a waxed or clay-covered cord and then dyed. The coated cord resisted the dye and left a plain design on a colored background. This process is commonly called tie or resist dyeing. Plain cloth shawls were decorated with elaborate borders, or bands of other techniques. Finally plain cloth was used as the basic fabric for most of the elaborate embroidery.

Tapestry technique

A tapestry, in the Peruvian textile group, includes any fabric in which the weft threads cross over and under equal units of tightly stretched warps, and in which the wefts are beaten up so that they cover the warps completely. The old Peruvians made very ambitious tapestries with elaborate designs. To insert a design each color must be woven back and forth only on the warps which it is to cover. Consequently, when two color areas join, they must be interlocked in some way

The Peruvian loom in schematic arrangement. (a) The loom bar. (b) and (c) Cords which fasten the warp to the loom bar. (d) Weave sword or shed stick. (e) One warp set. (f) Heddle or heald rod. (g) Separated warp set. (h) Weft thread. (i) Bobbin-spindle. (j) Inserted wefts



or a slit will be left. The Peruvians often left the slits open as part of the design effect, outlining a figure or unit with open slits. They knew several methods of closing the slits, however, the most common being the looping of alternating weft threads from contacting color areas about a common warp. Even curvilinear figures were effected in which wefts were made to cross warps at other than right angles by being beaten up more closely in one part than in another.

Respect for these tapestries is enhanced when comparisons are made with the work of other famous weavers, old and modern. According to Mr. Crawford the Gobelin tapestries seldom contain more than twenty warps per inch, while one Peruvian tapestry contained forty-two warps per inch and from 260 to 280 weft picks per inch. This is due partly to the spinning of the thread and partly to the weaving.

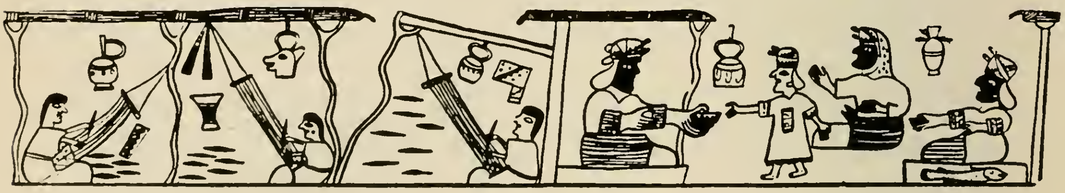
Pattern weaving

Design patterns in these textiles were also inserted by special manipulation of colored weft threads over and under arbitrary groups of warp. This is known as a weft pattern weave, or "bobbin" weave, since wefts are inserted with the bobbin itself. In many pieces the colored weft threads are brought to the front surface of the cloth only where needed to fit the design, and carried in loose floats on the reverse side. However, the Peruvian weavers were skillful enough to finish a pattern weave on both sides by planning a design which eliminated the necessity of floats. A similar effect was gained with colored warps instead of wefts. The warp threads were arranged in color bands on the loom, and a design was produced by special shedding which brought the desired colors to the fore. This latter technique, known as warp pattern weaving, was particularly common for designing belts, and the combinations of sheds to produce a geometric design was reduced to a mathematical formula. Interestingly enough, this same technique of belt designing is still used by the Indians today.

In embroidery the Peruvian Indians achieved colossal effects. Embroidery is the addition of a needle-work design to a plain woven fabric. Copper and silver needles with the ends bent over for eyes, and pierced fine thorn needles have been found with which this work was done. Even decorated cane and reed needle cases are found. The technique of embroidery is not basically difficult, although it requires delicate skill and tremendous patience. There is no necessity for following the weave pattern in applying needle work to a fabric, and consequently the complexity and variety of design are almost unlimited. The amazing part of the Peruvian embroidery is the large areas which are solidly covered with polychrome needle designs of ornate figures. In some of the Nazca and Paracas embroideries units of complex mythical animal figures are repeated again and again with machine-like accuracy.

Some samples of needle work show stitches that follow the weave pattern, much like the samplers designed for pillow covers today. These are apt to be confused with the true brocades. The basic difference is that a brocaded thread is added during the actual weaving of the fabric. These additional ornamental threads are more loosely beaten up than the regular wefts and consequently stand out like needle work. The brocaded thread need not follow the regular over and under weave pattern, but may be manipulated to appear on the face of the fabric only where needed in the design. True brocades are common in the Peruvian collections.

The gamut of weaving techniques known to these pre-Spanish artisans need not be described in detail, although the experts have



A design from an Early Chimú vessel which is now on exhibit in the British Museum. Here marvelled at the versatility of the weaving tricks known. True gauze is common, in which the adjoining warps are twisted one half turn about each other between each insertion of weft. Knitting, crocheting, and special forms of needle work such as pile knotting and tubular weaves, are not uncommon. A typical refinement is found in the so-called "double" cloth, in which two sets of parallel warps and corresponding wefts of contrasting colors are used. The wefts alternate from one set of warps to the other to produce designs. The finished piece has the same design on both sides, only in reversed colors, and except where the designs interlace the two webs are separate.

The actual specimens confirm the costumes described by the early chroniclers. In the various geographical and cultural regions there was considerable variation in the costume details, but the pattern was essentially the same. Painted figures on pottery as well as embroidered figures on textiles also augment and confirm the historical and specimen record. Aside from clothing, the spinning and weaving technique was used for other purposes. Large pieces of cloth were used for hangings, even on the walls of some of the coastal tombs. Coarse, stuffed textiles were used as sleeping mats. Fringes and tassels, cords, nets, and slings are common archæological finds.

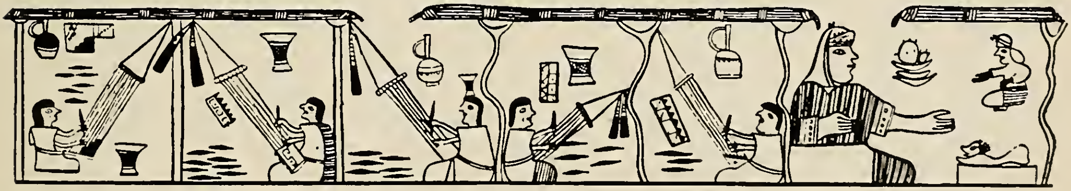
Textile designs have had considerable influence in the ornaments applied to other media. In some periods the ceramic and textile designs are quite distinct, but in others, such as the early Nazca, the same mythical animal figures appear in both groups. Quite apart from this use of the same figures are groups of ceramics in several periods that have designs which in their geometric repetition appear to have been copied from textile patterns. It is impossible to be certain about the sequence of application of a design style, but the painted pottery designs bear such a close resemblance to the woven figures that they are commonly called "textile pattern."

Textile designs were probably applied to the carved stone figures. In the highlands of Bolivia where climatic conditions are unfavorable to the preservation of such fragile material as cloth, our whole knowledge of textile patterns is based on a study of the fine incised designs on stone statues. The incised design areas on the statues are so arranged that they appear to represent clothing. We know that the highland style spread to the coast in the middle periods of Peruvian archæological history, and there tapestries are found with designs which are virtually replicas of the incised statue decorations. A decorated stone gateway at Tiahuanaco has a series of running figures in the design pattern which suggests, from coastal textile counterparts, a representation of a tapestry hanging. Likewise on the coast of Peru where adobe is used in place of stone for a building material, wall arabesques, combining relief and painting, are patterned after textile designs.

Archæological significance

To the craftsman the Peruvian textiles are of interest for the technique and skill which they display. The art student is interested chiefly in the designs and their treatment. Both of these studies depend only on the collection of textiles, *per se*. The archæologist, however, is interested in the chronological problem involved, which demands a rather detailed account of the excavation of the graves which contained the textiles and considerable information about the pottery and other artifacts associated with these graves.

The prehistory of Peru has been divided into several periods, largely on the analysis and isolation of distinct ceramics. The



weavers with "girdle-back" looms, bobbin-spindles, water jugs, and design patterns are depicted following summary gives a simplified picture of the present sequences, which fall, roughly speaking, between the beginning of the Christian era and the Spanish invasion of 1532.

EARLY PERIODS: Early Nazca, south coast of Peru; Early Chimu, north coast of Peru; Classic Tiahuanaco, Bolivia. A period of intense styles, with elaborate designs of a realistic nature.

MIDDLE PERIODS: Epigonal periods on coast of Peru. An influx of highland Bolivian (Tiahuanaco) influence on the coast of Peru, with following local developments, which generally trend toward stylization.

LATE PERIODS: Late Nazca (Ica); Late Chimú, Decadent Tiahuanaco. Further differentiation in geographic regions but generally toward geometric design.

INCA PERIOD: Inca geometric patterns and characteristic artifacts follow their political spread over all Peru and Bolivia.

The identification of textiles with these various periods has been done largely by analogy of fabric and ceramic designs. This is principally because there are very little data in existing textile collections. On the north coast of Peru, for example, no textiles have been positively associated with Early Chimú ceramics, in spite of the tremendous collections of the latter. About the only extensive study of this subject has been made by Lila M. O'Neale and A. L. Kroeber (*Textile Periods in Ancient Peru*, University of California publications in American Archæology and Ethnology, Vol. XXVIII, 1930–31). From this we learn many interesting things about Peruvian weaving.

Basic characteristics of weaving

First, there are a number of rather basic characteristics of the weaving art that occur in all periods and thus unite, rather than differentiate, Peruvian prehistory. Cotton and wool were used in all periods, as before stated. Most all wool (warp and weft) fabrics come from the early periods, which shows that the trade of raw materials, coastal cotton for highland wool, had an early start. All fabrics were woven on the girdle-back loom, or on smaller looms. Furthermore, no changes can be detected in the loom-type throughout the various periods, which implies that the textile technique of the early periods was as fully developed as at any of the later times. The dyes appear in every period, although the combinations of colors which typify a region or period may vary. Finally, virtually all techniques of weaving appear in Early, Middle, and Late periods, although the emphasis changes considerably. That is, the weavers of one period selected a technique which they chose to emphasize, but their adherence to this technique was not because of lack of knowledge of the others.

The Early period (referring to Early Nazca and a special variant of it found at Paracas) is characterized by elaborate embroideries of complex animal figures, in which the needle work covers large areas of the fabric. Three-dimensional knitting is found only in this period, while tie-dyeing and double cloth is practically absent. The design is largely of a realistic nature.

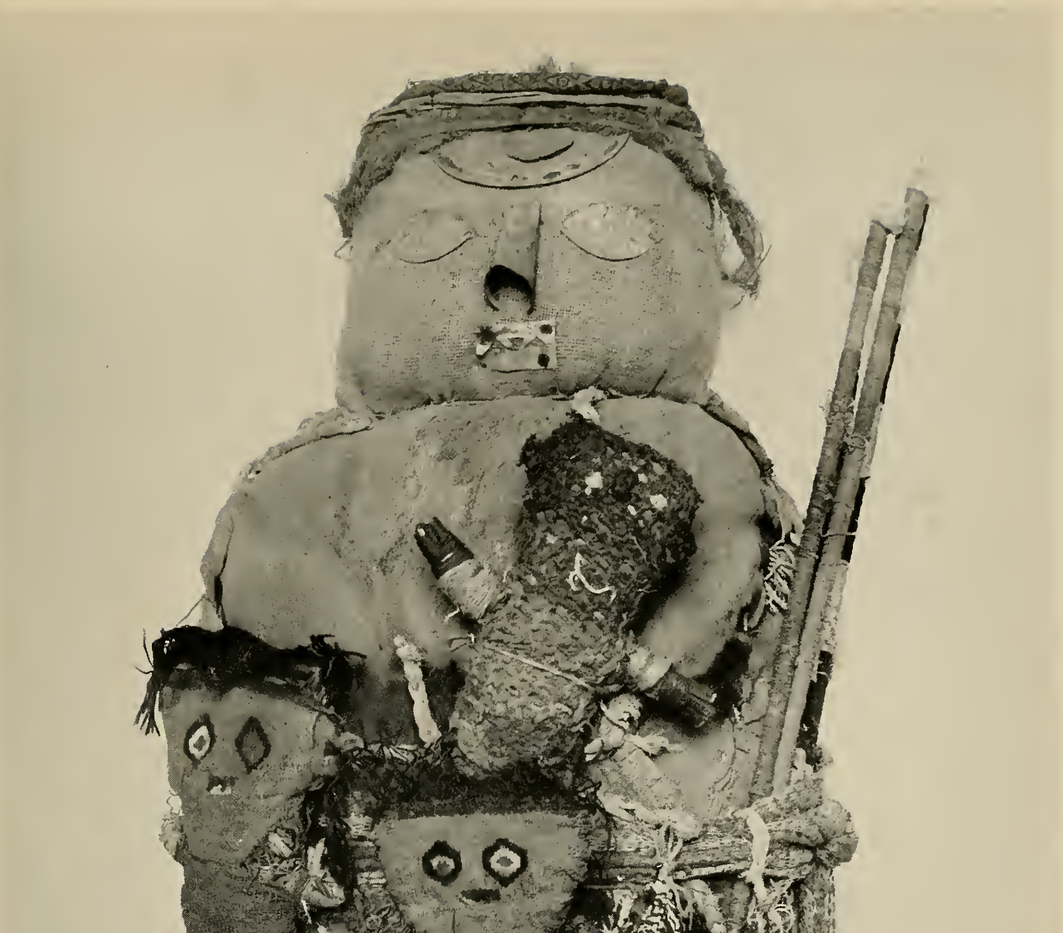
The Middle period introduces ambitious tapestries composed of design elements which have become stylized, that is, have utilized elements of realistic figures in a pattern design. Double cloth is characteristic of the Middle periods.

The Late periods place the emphasis on gauze, brocade, and pattern weaves, although tapestry and double cloth is still common. Tie-dyed and painted cloth are typical. The textile style, like the ceramic style, emphasizes geometric design.

Inca and Spanish weaving

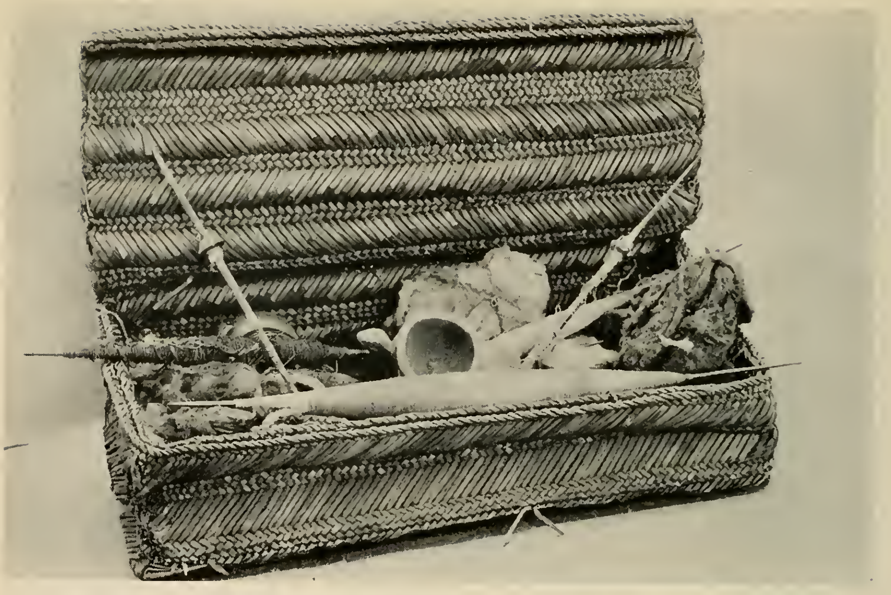
In the Inca period weaving became formalized into quantity production, with a corresponding reduction of design to mechanical geometric patterns. Weaving of ponchos persisted well into the Spanish times, as is witnessed by the use of gold and silver threads, and the incorporation of European figures, geometric, human and animal, into the design. Actually the art of weaving has never died out and modern Indian weavers are still to be seen, although their products are now rather ordinary blankets for home use.

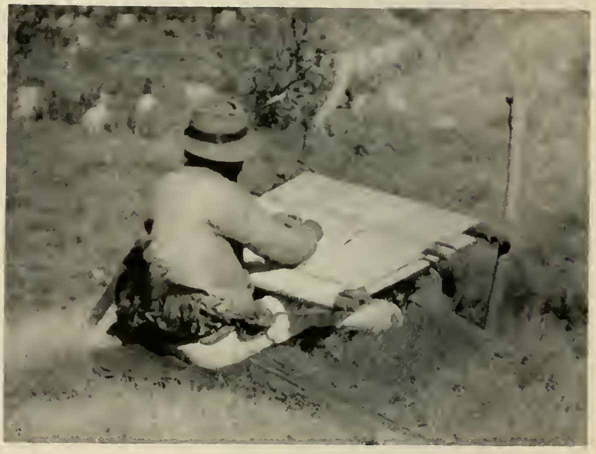
The textile art of the Peruvians is one of the finest examples of the achievements of that civilization. A thorough appreciation really demands seeing and examining the numerous examples in museum collections. While the Europeans checked the further development of indigenous culture in Peru by introducing a higher energy civilization, the products of the loom still stand as one of the great artistic and technical accomplishments of the world.



A Mummy Bundle from the Coast of Peru

The dessicated body, in flexed position, is wrapped in fine cloth inside the large bundle. The false head on top is for decorative purposes. *Dolls, woven bags, and ceremonial sticks decorate the bundle. Most of the Peruvian cloth is found as mummy wrappings*



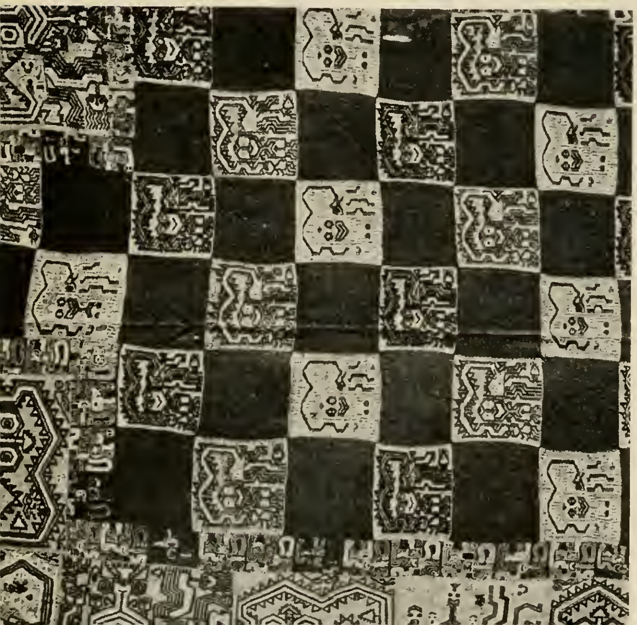


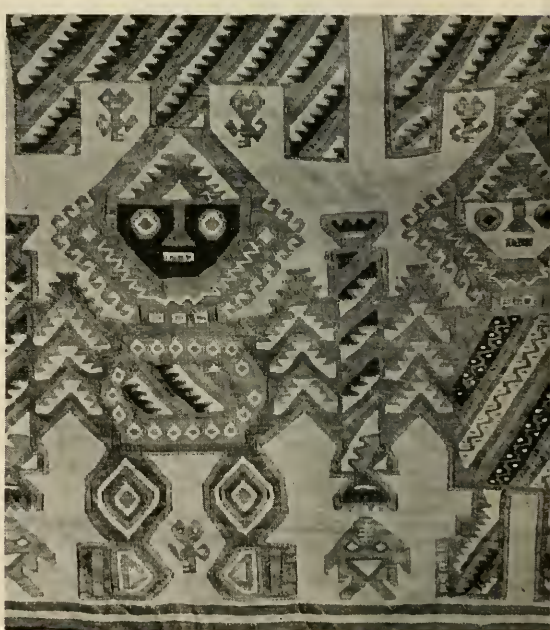
(Above) A woman's work basket containing spindles, bobbins, carded fiber, and other materials for spinning and weaving

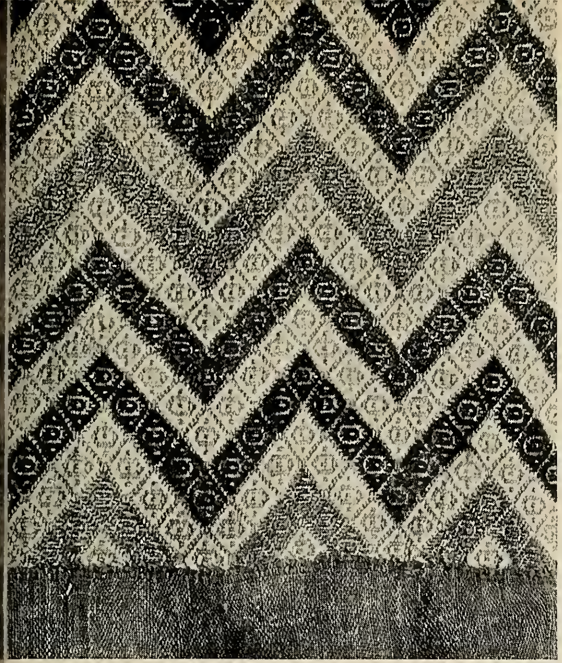
(Right) The girdle-back loom is still used by men and women weavers in Peru

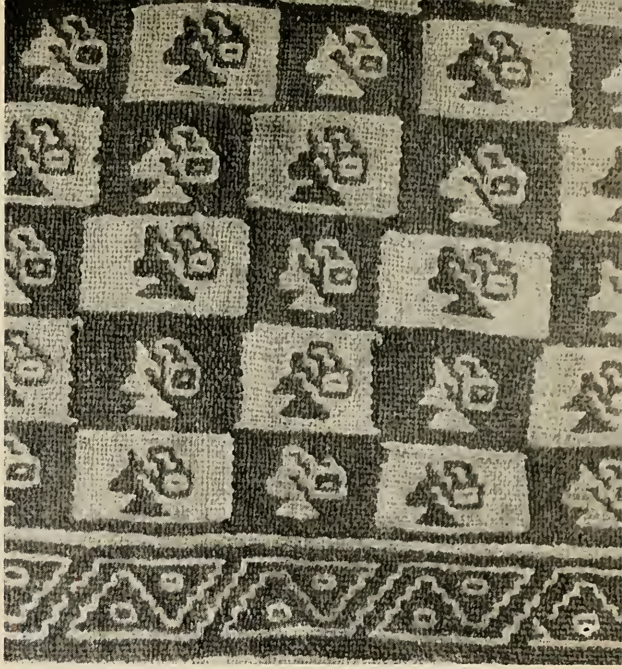
(Below, left) An elaborate example of Paracas type solid polychrome embroidery in the private collection of the Canal brothers

(Right) An excellent tapestry from Pachacamac, Peru, with slits left open between color areas as part of the design, in the so-called Kelim technique







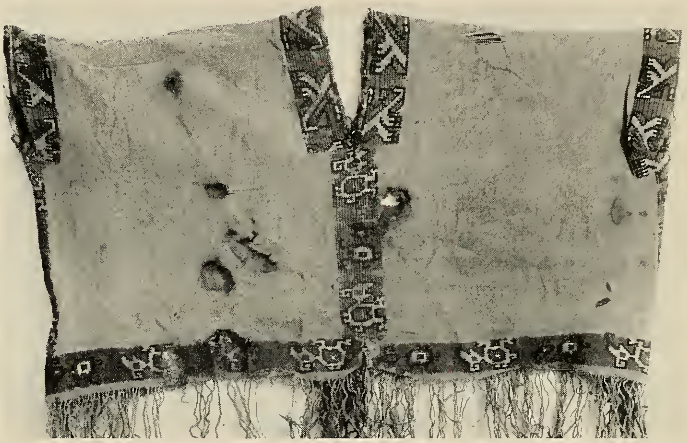


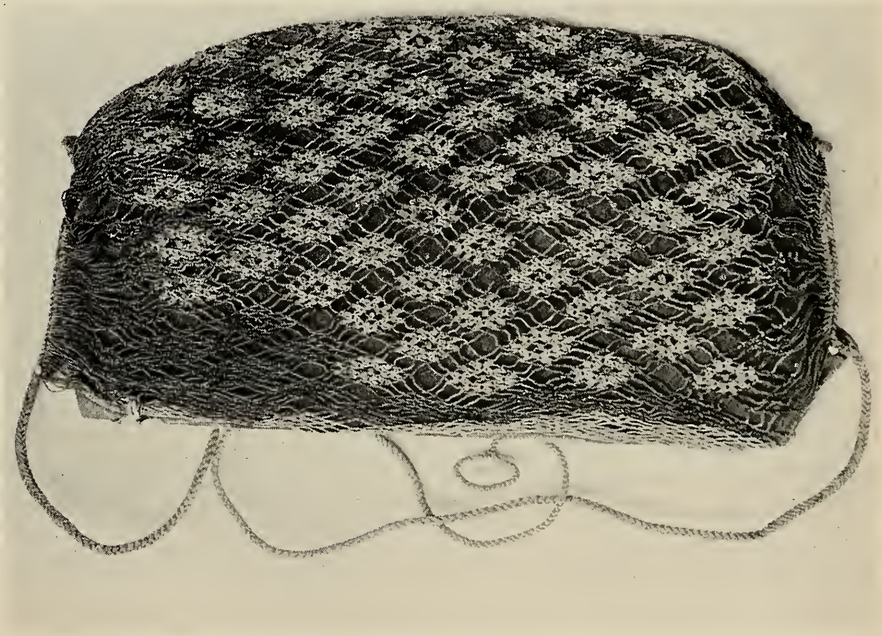
Above, left) A weft pattern eave in polychrome design for breech cloth

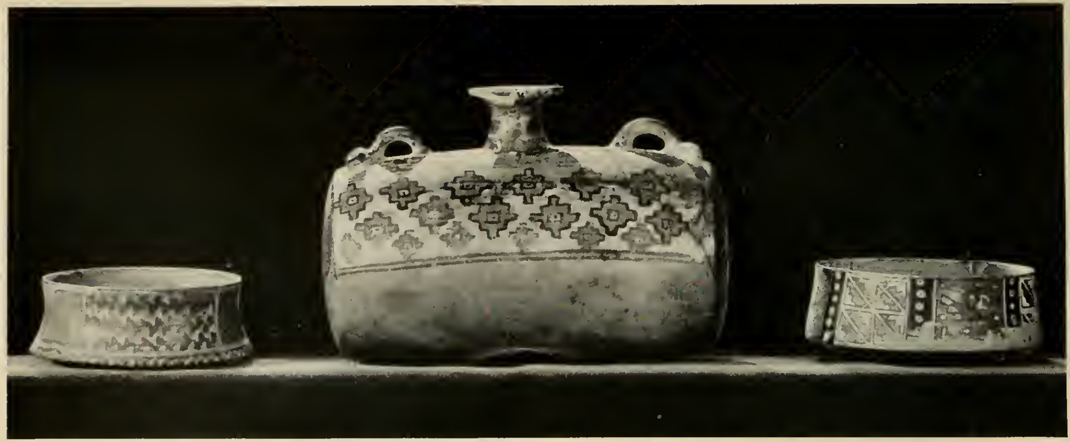
Right) A double cloth in brown nd white with bird design

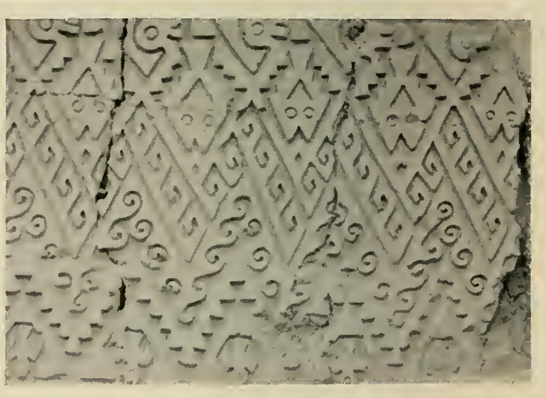
Right) A complete poncho-arment with needle work decoation around the borders

Below) A netted cap of maguey ast-fiber for the head. Similar aps have actually been found on e heads of mummies





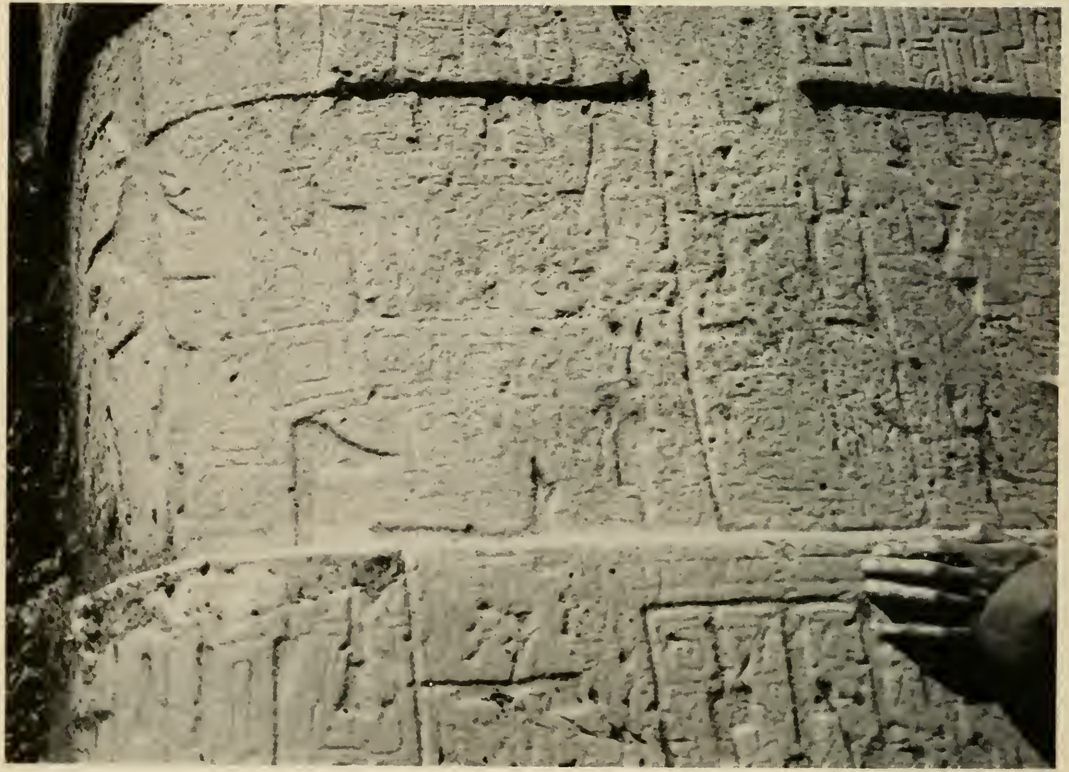




(Above) Inca pottery which illustrates the application of textile designs to ceramics

(Right) A wall of La Sentinela ruin at Chincha, Peru, with a relief design that is a direct copy of a textile design

(Below) Incised design of a running figure on the waist of a stone statue found in the highland Bolivian site of Tiahuanaco. Similar designs have been found in coast tapestries and indicate that the incised designs on the statues probably represent clothing



Friday Harbor's Nets and Dredges

Harvesting marine life from the waters of Puget Sound for study at the Biological Laboratories of Friday Harbor

By HARRIET GEITHMANN

"I'VE got a little animal in my pocket," muttered a stranger at the door of Prof. Trevor Kincaid's office in Johnson Hall at the University of Washington, as we sat talking about the pioneer days of the Oceanographic Laboratories at Friday Harbor. "I found him in a can of cocoa."

The zoölogist who has made himself dear to the hearts of thousands of students as well as to the general public took a good look at the tiny frog which the stranger proffered him, then replied with that whimsical smile of his: "He is not a native of this country. Somewhere along the line of grinding up the cocoa he hopped in. As far as poison is concerned, you could swallow a dozen like him and it would do you no harm, but it might prejudice you a little against that particular can of cocoa."

A perfect location

Just an incident in the crowded day of this scientist, the real daddy of Friday Harbor's international fame today as an ideal place for the study of oceanography.

He, it was, who had the vision more than thirty years ago to choose Friday Harbor in the tawny San Juans of Puget Sound as the perfect location for a biological station, because of the wealth of marine fauna and flora readily available in the neighboring waters.

Time has but confirmed the wisdom of his choice. This pioneer in science personally directed the research work at Friday Harbor from 1910 to 1914; then along came the Japanese or Pacific oyster to claim a goodly slice of his time.

In Professor Kincaid's footsteps followed that friendly and famous botanist, Dr. T. C. Frye, who took over the reins of government at Friday Harbor and put fifteen of the best years of his life into its development as a marine station.

Due to the prescience and persistent efforts of these two scientists, was the sound foundation of the field laboratories at Friday Harbor laid. On this groundwork, the past five years, under the directorship of Dr. Thomas G. Thompson, professor of chemistry, have witnessed greater progress in the field of marine research than in the preceding thirty years of plucky pioneering.

About one hundred miles northwest of Seattle lies Friday Harbor on the rugged shores of San Juan, the second largest island in the San Juan Archipelago, 172 isles populated with people, pixies, and sea parrots, 57 varieties of enchanted islands bounded on the north by the Gulf of Georgia, on the west by the Canal de Haro, on the east by Rosario Strait, and on the south by the Strait of Juan de Fuca, that ocean lane over which travels the commerce of the world via the Pacific.

It was on San Juan that a tempest in a teapot was staged in 1859, one which threatened forthwith to plunge two of the greatest nations on earth into war.

On San Juan the Union Jack, emblematic of British authority, floated for the last time within Uncle Sam's domain. Here, Lyman A. Cutler, an American frontiersman, shot a British pig bent on rooting up his potato patch.

Boundary lines

On the heels of this shot which echoed through the evergreens on San Juan and reverberated in Pall Mall of London and on around the globe, a shot which but precipitated an old boundary question, military events crowded one another; finally, in 1872 England and America buried the hatchet, after Kaiser Wilhelm, grandfather of the present royal woodchopper at Doorn, decided that the boundary line ran through the Haro Strait to the west where the water is 100 to 190 fathoms deep instead of Rosario to the east where it is less than 50 fathoms deep.

The death of the British porker simply stirred up the question of boundary lines and the ownership of 172 tawny isles instead of "1000 desolate and volcanic islands" as one of the senators called them derisively while the tempest raged and he was thinking in terms of "every inch and acre up to 49 or war."

Garden of the sea

Today the weather-beaten blockhouses and barracks remain to tell the story of the soldiery that once trod the forest trails of San Juan in the making of international history. Today, he who saunters along the beaches of Friday Harbor's "unique garden of the sea" may discover not only starfish ranging in color from lavender to purple and lemon to orange, sea urchins and sea anemones of every hue, and giant kelp, but also he may even stumble across military buttons which once adorned the uniforms of those British and American troops who occupied the island during that long and famous fracas.

On this historical island are the field laboratories of the University of Washington's Oceanographic Laboratories some two miles from Friday Harbor, the county seat of San Juan County.

And why the name of Friday Harbor? More than eighty-five years ago some 1300 sheep were being herded by a Kanaka for the Hudson's Bay Company on Bellevue Farm in the smiling valleys of San Juan. When an English boat sailed into the harbor, the Captain sent a messenger to the old Kanaka to ask him the name of the harbor. He did not know. Then they asked for his name. "Friday," he replied; whereupon the Captain said, "I'll call this Friday Harbor." Subsequent efforts to change the name to Bellevue have luckily failed. The Hawaiian sheepherder's name clings to this romantic spot.

Through the faithful efforts of Dean Herbert T. Condon, the present campus of 484 acres at Friday Harbor, formerly an old military reservation, was deeded to the University of Washington by Act of Congress in 1921. This campus, with its two miles of indented shoreline, commands a view that is immense, — the Cascade Range and Mount Baker, that snow-crowned volcano all but asleep, which loom up beyond the glistening channels of the San Juan Archipelago. Approximately $100,000 worth of buildings, six laboratories of concrete and hollow tile with red tile roofs shining among the evergreens, a library of 4000 volumes, a stockroom, a dining and social hall, and the director's and curator's cottages skirt the shoreline.

Open the year round for investigation, and every summer for a session of nine weeks from June to August, are Friday Harbor Laboratories. Here more than one hundred independent investigators and students hailing from all points of the compass congregate every summer and fill up the colony of tents. The gathering of the clans represents many states and foreign countries, men and women who work out their individual problems in oceanographic zoölogy, botany, chemistry, and bacteriology.

Emigrants from Puget Sound

Allied with Friday Harbor and backing up all its activities are the main Oceanographic Laboratories on the campus of the University of Washington at Seattle, an imposing three-story Gothic structure of brick dedicated in 1932 to the field of oceanographic research by the eminent physicist, Dr. Robert A. Millikan. It stands on the shores of Portage Bay, which links Lake Washington with Lake Union, from which the Lake Washington Canal with its upper and lower government locks, second in size to those of Panama, lead the way out to Puget Sound and deep water.

This building, which houses the offices of Doctor Thompson, is interested primarily in the fact that 70 per cent of the world's surface is water. Beneath its roof are numerous aquaria built of soapstone and glass, through which circulates a constant stream of sea water from the Strait of Juan de Fuca, — 60,000 gallons which were brought in on a huge scow and poured into the storage tanks of concrete from whence the centrifugal pumps force it up through the hard rubber pipes of the building and into the various aquaria. En route the water is cooled to 9° C. the average temperature of Puget Sound.

In these tanks is many an emigrant from the waters of Puget Sound, the San Juan Archipelago and beyond: bristling sea urchins of all sizes carrying shells on their spines, sea anemones of all colors, some of which look like fuzzy cauliflowers in an alabaster vase or an Edam cheese, or a girl's beret trimmed with ostrich plumes or flowers of vivid hue, hermit crabs living in the homes of snails, soft-shelled clams in sandstone, demure as white leghorn hens, pop-eyed flounders that sweep across the bottom of the tank with the pride of a peacock, scallops gallore, teredos operating on sawed-off sticks of wood and piling up sawdust, demonstrating that they can eat right through a wooden ship, giant barnacles six inches tall and four inches thick, working overtime in their crusty homes, spider crabs, baby octopuses, shrimps and brilliant starfish and seaweeds.

Here the scientists have a rich opportunity to study oceanographic life at first hand in the various laboratories dedicated to chemistry, botany, zoölogy, bacteriology and physics. In order better to accommodate these various laboratories, the corridors circle the outer side of the building, an excellent feature.

The laboratory boat

A stone's throw away floats the "Catalyst," or laboratory boat, a seaworthy craft which also was completed in 1932 and dedicated to oceanographic research. All Doctor Thompson has to do when he wants to confer with Capt. C. T. Larsen is to cross his office and shout out the window, "Oh, Captain." Presently the skipper strides in, a sturdy Norwegian-American mariner who was chosen from 397 applications for the responsible post of commanding the "Catalyst." Since 1903, the Captain has been sailing out of Seattle on windjammers, famous ships of both sail and steam over all the seas that encircle the globe. For twelve years his good wife sailed with him.

With the skipper is associated Louis Mortensen, a Danish-American cook, who knows well the art of keeping up the morale of the scientists on a cruise, because the Director believes that, if an army travels on its belly, so do the scientists. When asked if he could cook for professors, he tartly replied: "Oh, I've cooked for millionaires before."

Personnel of the "Catalyst"

The rest of the crew consists of Frank Melder, the engineer, a student of mechanical engineering with all the necessary papers to qualify him for the job, and the deck hands or students and professors aboard, for the "Catalyst" carries a total of sixteen.

This 120-horsepower diesel-driven research boat, already famous, is 75 feet long with an 18-foot beam. Its hull is constructed out of yellow Alaska cedar, its rib of oak, and all the trimmings fore and aft are of the precious teakwood. Amidships is the laboratory, 10 by 18 feet, fully equipped for oceanographic research work. Here is Dr. Clinton L. Utterback's own invention for the penetration of light in the sea, a regular octopus of cast-iron with two eyes, photo-electric cells, and a rubber cable 500 feet long in which there are several electric wires. Operated by the electric winch is a quarter-inch cable of stainless steel, one length 15,000 feet long, which is used for the sampling of both water and plankton.

The galley accommodates a gas range, a hot-water heater, and a refrigerator. It was around this friendly galley that a Haida buck was loitering suspiciously as the "Catalyst" lay anchored in the harbor of Skidegate in the Queen Charlotte Islands. The Haidas had entertained the scientists royally in their village, and in return Doctor Thompson invited them to visit the "Catalyst." The other bucks of the tribe were particularly interested in the engine room, and the squaws crowded into the galley, where the gas boiled water and manufactured ice at the same time.

"Keep an eye on that buck," Doctor Thompson warned Louis.

"Oh, I know what he wants; he's all right," returned Louis.

Finally, the curious fellow asked Louis, "What do you feed these wise men to make them so wise?"

When Louis told him that they ate salmon and codfish just like the Indians, he sauntered off profoundly disappointed. The pilot room, where the skipper has his bunk, his books, and his nautical instruments, is also the social hall.

Dedicated to oceanographic research

The "Catalyst," which operates out of Seattle from October to June and from Friday Harbor the rest of the year, has a cruising radius of 3000 miles, all of Puget Sound, both the inland and outside passages to Alaska and to the south of Cape Flattery. Already has this laboratory boat sailed more then 20,000 miles and called on some 2000 different stations in its brief career of investigation of the North Pacific waters, working in each station from three to four hours, sampling the water and plankton, dredging and harvesting specimens of marine life.

Many a person asks, "Whence comes the name of 'Catalyst'?" While the Director explains it scientifically thus, "A catalyst is a substance which will alter the speed of a reaction without itself undergoing any change," perhaps the most graphic explanation comes from Mrs. Robert A. Millikan: "When an Arab chieftain died, he left his three sons 17 horses, ½ of the horses for the first boy, ⅓ for the second boy and ⅑ for the third. The question arose about the division of the horses. Another Arab solved the problem by adding a horse to the 17 so that the first son got ½ of 18 or 9, the second ⅓ or 6 and the third ⅑ or two which made a total of 17. The Arab's 18th horse was the catalyst."

To the Rockefeller Foundation, the Pacific Northwest is indebted for not only the Oceanographic Laboratories on the campus of the University of Washington but also for the "Catalyst," moored at the dock in Portage Bay, the two stanch allies of the field laboratories at Friday Harbor, a generous legacy for the use of all scientists, north, south, east, and west.

"And don't forget the staff," added Doctor Thompson.

There are Dr. John E. Guberlet, who is concerned with fish diseases, embryology, and the general distribution of marine organisms in the sea; Dr. Bernard S. Henry, who is primarily interested in sea bacteria, which is practically a new phase of bacteriology; Dr. Robert C. Miller, who has traveled the world over in his study of the teredo and the distribution of zoo-plankton; Dr. Earl R. Norris, who is concentrating on the biochemistry and particularly the distribution of vitamins in marine organisms; Dr. Lyman D. Phifer, who is interested in phytoplankton; Dr. George B. Rigg, who is interested in the physiology of marine plants; Dr. Clinton L. Utterback, who is famous for his work in the penetration of light in sea water and the study of other physical phenomena in the sea; and genial Forrest Fuller, the curator at Friday Harbor who is responsible for the maintenance of the buildings and grounds.

The chemistry of the sea

Both Doctor Thompson and Dr. Rex J. Robinson are particularly interested in the chemistry of the sea and the nature of the ocean currents. These men keep the "Catalyst" cruising, and the laboratories at Friday Harbor and on the University of Washington campus busy as beehives working overtime delving into the private life of the teredo and the barnacle, a menace to maritime commerce, the starfish and the shrimp, the pop-eyed flounder and the hermit crab, dredging the bottom of the sea, adding page by page to the world's book of scientific knowledge on oceanography, and justifying year by year the pioneer dreams of the founder of the present field laboratories at Friday Harbor, Prof. Trevor Kincaid, and all the other scientists who have dedicated both time and energy to those dreams which have finally come true.

A Biological Station in Puget Sound

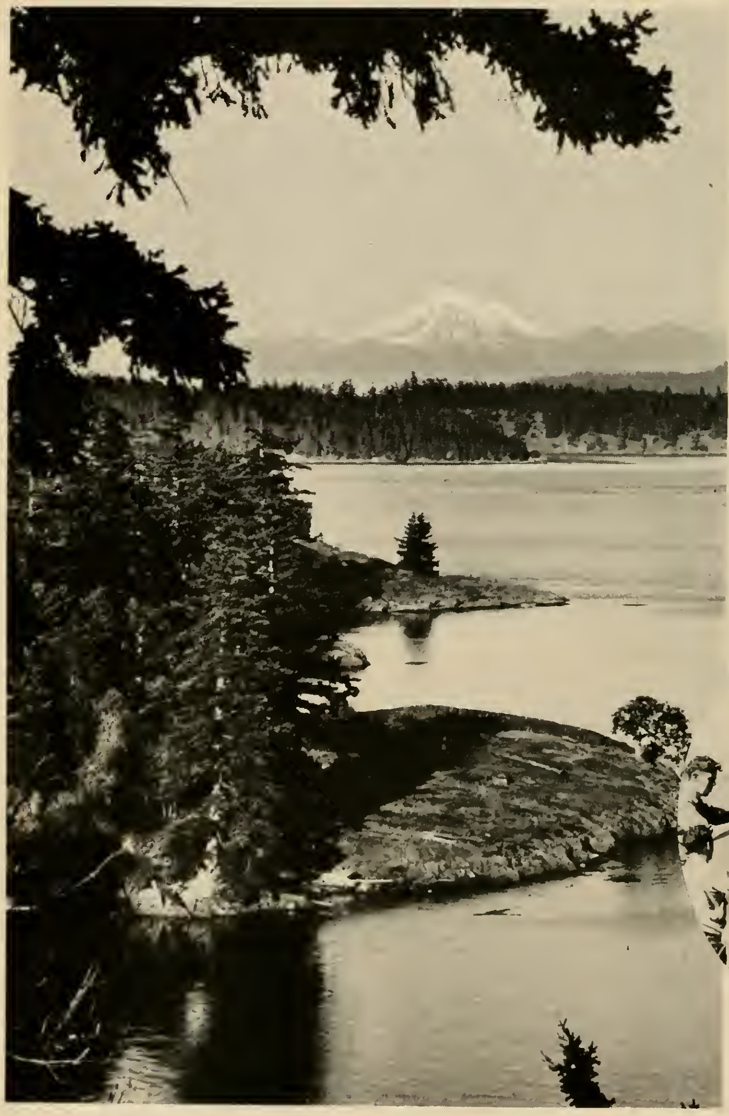
Dr. Robert C. Miller examining a specimen which has been brought up from the sea in a plankton net

Friday Harbor in the San Juan Islands of Puget Sound is an ideal location for a biological station, for the neighboring waters abound in marine fauna and flora. Photograph by J. A. McCormick

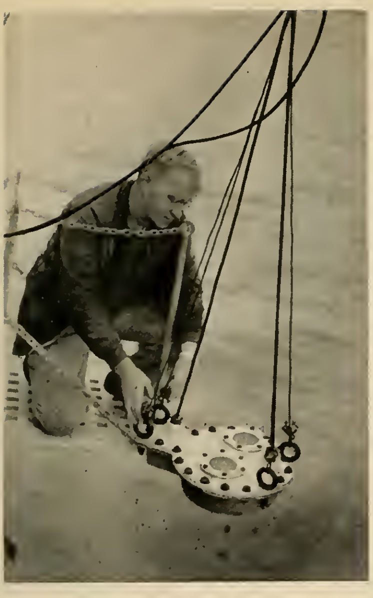
Scientific Collecting Amid Scenic Beauties

From the site of the Oceanographic Laboratories at Friday Harbor may be seen the snow-covered volcano of Mount Baker, which is pictured in the photograph below. The present campus of the Laboratories includes 464 acres, with two miles of indented shoreline. Photograph by J. A. McCormick

Dr. T. G. Thompson, the director of the Laboratories, waiting at the cable to report the filling of bottles with samples of water from the ocean depth



(Below) The dredge, heavily loaded with marine specimens, is enthusiastically greeted by the Laboratory students

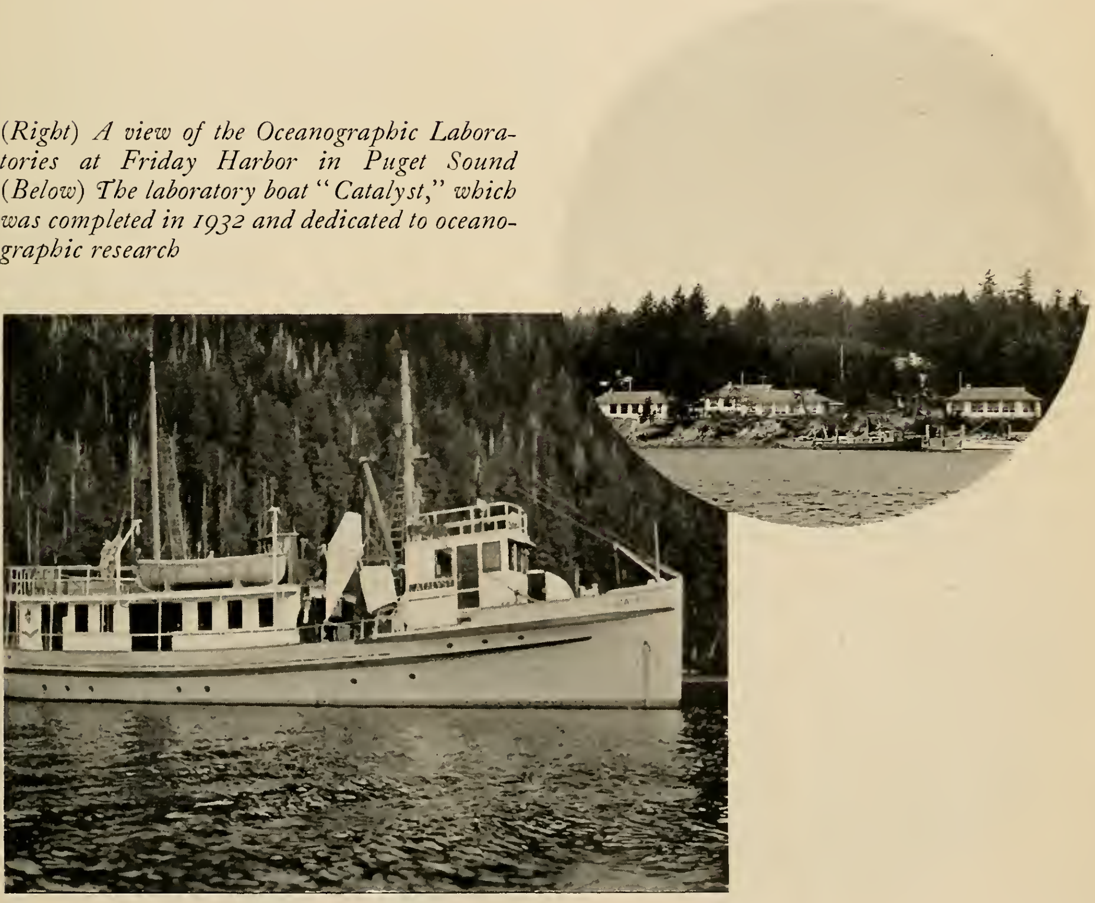


Dr. Clinton L. Utterback preparing to lower his cast-iron octopus, his own invention for measuring the penetration of light in the sea.

Frank Melder, the engineer, at the controls which raise and lower the nets, — a real job, for the "Catalyst" carries almost three miles of cable

Louis, the cook, views the harvest of the dredge, spread out on deck. Along the deck house may be seen the storage tanks for live specimens from the sea

(Right) A view of the Oceanographic Laboratories at Friday Harbor in Puget Sound (Below) The laboratory boat "Catalyst," which was completed in 1932 and dedicated to oceanographic research



A pipe fish caught in Puget Sound. It is a relative of the sea horse

(Right) Captain C. T. Larsen with a 500-pound porpoise which was harpooned just outside Cape Flattery and west of Vancouver Island

(Below) Playmates at Friday Harbor. The young son of two laboratory students getting acquainted with a baby seal

Science in the Field and in the Laboratory

American Museum Activities, Expeditions, Education, and Meetings of Societies

Edited by A. KATHERINE BERGER

The cover picture for June "Natural History"

The June issue of NATURAL HISTORY bears on its cover a sketch drawn by George F. Mason, which shows a white gyrfalcon breaking its speed after striking. The feathers flying were apparently ripped from the head or neck of its victim.

The flight of the gyr is marked by an appearance of power befitting its size and shape, and combines in an extraordinary degree swiftness, and ability to turn readily. When taught to wait on, it does so in majestic style, often at a stupendous height; so great is the vehemence with which the gyr flies and stoops, that the quarry is struck down with a blow so violent that it is either killed outright or stunned by the shock.

The Third Scarritt Expedition

Through the continued generosity of Mr. H. S. Scarritt, the work of the Scarritt Expeditions will be resumed this summer in a new field. The first Scarritt Expedition in 1930–31 and the second in 1933–34 were both directed to Patagonia, where large collections of very ancient fossil mammals were made.

The third expedition will also seek early fossil mammals, but this time in Montana. The region to be visited has yielded the oldest known remains of primates, fossil lemurs that represent the earliest mammalian ancestry of man, and the expedition hopes to add to knowledge of these extremely important and still very little known creatures, as well as to collect other primitive mammals.

Ever since the founding of its department of vertebrate palæontology, the American Museum has made special efforts to investigate and collect the earliest mammals, especially those of the Palæocene epoch, and the coming expedition will fill an important gap in its collections, which already are incomparably the best in the world.

Like the first two Scarritt Expeditions, this one will be under the leadership of Dr. George Gaylord Simpson of the Museum staff, who will be accompanied by Mr. Albert C. Silberling, a Montana collector. Mr. Fenley Hunter, a Life Member of the Museum, is also contributing to the expedition and, it is expected, will accompany it for a month.

The Hispaniola Expedition

A letter dated April 26 from W. G. Hassler of the department of herpetology, American Museum, announces the safe arrival of the Hispaniola Expedition at Port au Prince, Haiti. Preparations were immediately made to explore St. Marc's, and from there the party journeyed to the cotton plantation of Dr. H. D. Barker of the Agricultural Service. At the time of writing, they were living at the Sugar Company's quarters and working the cotton field out in the dry plain about eight miles distant.

One interesting development so far is a collection of live material, including an adult iguana with a young one, and a baby crocodile, which has formed the nucleus of an exhibit of local reptiles, installed by request at the Agricultural College, Damien. Several tables in the main hall of the building are laden with jars and aquariums of snakes and lizards, and the big iguana is tied in a corner, where it can wander about in some grass and rocks that have been provided for it. A label over the exhibit indicates that the animals were collected by the expedition, and that at the conclusion of the exhibit, they will be sent to the American Museum.

A number of tourists and townspeople have already viewed the exhibit.

Morden Expedition for Hawaiian Fishes

The William J. Morden collection of Caranx-like fishes made in Honolulu this spring, comprising several species belonging to four genera, has proved of value in connection with a study of the taxonomy and considerable age changes in this group, which is being carried forward in the American Museum.

This Hawaiian material has already been used in the preparation of a *Novitates* in which it is shown that one form, the so-called "akule," ranges from Hawaii to Japan, as distinguished from a related form in the Philippines; and in which an allied form from the South Pacific is described as new. Young of the "ulua," which, when adult, is one of the most important Island food fishes, are now being examined critically. This species is closely related to the "horse-eyed Jack" of the Bahamas, but seems to grow differently, certain characters which differentiate the two becoming noticeable in it at a length of six or eight inches.

The fishes, preserved in formalin, then wrapped in oiled paper and sent to the Museum by parcel post, arrived in excellent condition. Mr. Morden found that native names were not very serviceable in distinguishing closely related kinds, those of a certain size and character in general being known by one name irrespective of species. When he returned to New York, he made arrangements for further material desired, to be shipped to the Museum as the season advanced and it became available.

Amateur Astronomers Association

During the summer months the radio programs given over Station WOR under the auspices of the Amateur Astronomers Association will be discontinued. It is hoped that they may be resumed in the fall. During June the programs will be as follows:

June 4 — The Story of Telescopes — Arthur Draper
June 11 — The Hayden Planetarium — Clyde Fisher
June 18 — Seeing Things with Our Brains — John J. O'Neill

Noted astronomer dies

Dr. Edwin B. Frost, director emeritus of the Yerkes Observatory, died on May 14 at the age of 68. Although blind since 1920, he had carried on with enthusiasm his astronomical work, including occasional public lectures. His autobiography, *An Astronomer's Life*, published in 1933, was reviewed in Natural History for November, 1934, by Dr. Clyde Fisher. One of the asteroids or minor planets was discovered by him and afterward named "Frostia" in his honor.

Planet notes for June

On June 22 at 2:38 a.m. (Eastern Daylight Saving Time) the sun reaches the summer solstice. This marks officially the beginning of summer in the northern hemisphere and winter in the southern hemisphere. Mercury, during the first part of the month, will set about an hour and a half after the sun, but later in the month it will be in the morning sky, rising about an hour before the sun. Venus continues to be most brilliant during this month, setting about three hours after the sun. Mars sets about midnight, and will be in conjunction with the moon on June 10. Jupiter sets about three hours after Mars. It is particularly interesting that at this time the half circle of the Ecliptic can be traced across the heavens from Jupiter in the east, through Mars overhead, and Venus in the west. Saturn rises as a morning star during this period about the time that Mars sets.

Astronomical gleanings

The various stars composing the beautiful and well-known constellation, the Pleiades, do not, as has been believed, have a common motion. By a comparison of two photographs made through the same telescope, — one recently, the other nearly seventy years ago, — it is discovered that each member of the cluster has a motion independent of the rest.

* * *

Einstein's theory of relativity has received another bit of verification at the hands of an American astronomer who has been studying Class O stars, the most massive stars known. Einstein's theory predicted that the spectra of such heavy stars should be shifted appreciably over toward the red end. This has been found, observationally, to be the case.

* * *

Dr. V. M. Slipher, director of the Lowell Observatory, states as a result of recent researches that the earth would look *blue*, could we view it from outer space.

American Museum educational activities

City College: On May 22nd the American Museum's department of education, in coöperation with the staff of the department of education of City College, entertained about 100 students from the upper junior and lower senior classes of the College, and members of the faculty.

Washington Irving High School: The entire student body and faculty members of Washington Irving High School enjoyed a Museum Day on the 23rd of May. Under the guidance of the American Museum's educational staff the students visited several exhibition halls and viewed special motion pictures.

Radio talks: The weekly radio talks over station WNYC have been continued and will last through June. These talks, given every Thursday at 5 p.m. by Messrs. John Saunders and Robert Coles, have been followed by free public tours of the Museum exhibits mentioned.

Summer courses in natural history: Two intensive out-of-door courses in natural history will be given during July and August by the Division of General Education of New York University under the sponsorship of the American Museum of Natural History and the garden clubs of Long Island. The instructors will be Miss Farida A. Wiley, staff assistant in the department of education at the American Museum of Natural History, and Mr. George T. Hastings, chairman of the biology department of Theodore Roosevelt High School. Headquarters for the courses will be at the State Institute for Applied Agriculture at Farmingdale, Long Island, thirty miles from New York. Further information as to dates, fees, and content of courses may be obtained from Miss Wiley.

Visit of crippled children: On April 25 about twenty-five crippled children and adults from Montefiore Hospital made their annual visit to the Museum. This is arranged for yearly by Mrs. Max Binswanger, a member of the American Museum, and is always pleasantly anticipated by both the patients and the nurses who accompany the group. The Museum trucks were used for transporting the chair- and bed-patients, who, upon arrival, were taken on a general tour of the Museum. After a special luncheon provided by Mrs. Binswanger the group saw several Museum films.

Craft work: The American Museum has coöperated with the American Institute of New York City in offering a course in craft work for boys and girls of high school age. Miss Agnes G. Kelly of the department of education has given the spring course which consists of instruction in the technique on gathering material and preparing exhibits. Among the crafts that have been taught are modeling, casting, and the construction of observation trays, insect mounting boards, and bird houses. Other institutions offering similar courses sponsored by the American Institute are the New York Zoölogical Park, New York University, and the Brooklyn Children's Museum.

Teacher training: On March 4 the Museum's department of education, in coöperation with the department of education of the College of the City of New York, introduced a new phase of teacher training. Under the supervision of Mrs. Ramsey and Miss Mastin an intensive three weeks' course of classroom observation, practice teaching, and special museum techniques is given to groups of senior students. These students are assigned to the Museum by the College faculty in charge of the practice teaching ordinarily done in the public schools of the city of New York. The first course was so favorably received that two additional courses were given, and it is planned to make this new feature an integral part of the college work.

Bear Mountain Trailside Museums: In May Bear Mountain Trails and Trailside Museums opened for the ninth season. They are maintained and operated jointly by the American Museum of Natural History and the Commissioners of Palisades Interstate Park, and are under the immediate supervision of Mr. William H. Carr, assistant curator in the Museum's department of education. In all, there are now five Trailside Museums in the fifty-seven acre area, and separate structures for botany, zoölogy, geology, crafts, history, and archæology. Two and one half miles of labelled outdoor nature trails acquaint visitors with the broad natural history features of the Hudson Highlands. The Trailside Zoo has been extended, and a large, circular snake pit displaying snakes, turtles, and lizards has proved a popular spot. During the past eight seasons, more than 2,000,000 people from all parts of the world have passed over the trails. A cordial invitation is extended to all members of the American Museum and their friends to visit the Nature Trails and Trailside Museums during the coming season.

International Nature Photography Exhibition

Country Life, Ltd., an English publication, has announced an international exhibition of nature photography, to be held in the "Whale Hall" of the British Museum (Natural History), London, S. W. 7, from October 16 to November 30, 1935.

This exhibition is being arranged by *Country Life* and is intended to show the best of Nature Photography from its inception. It will be confined to birds and mammals photographed alive and in their wild state, and it is hoped that the exhibition will be the largest and most comprehensive of its kind ever held.

There is no entrance fee, and the number of photographs that can be sent is not limited; neither must they be the sole work of the exhibitor. No distinction will be made between amateur and professional.

The latest date for receiving entries is August 31, 1935. Entry forms and full information may be obtained from *Country Life*, 20 Tavistock Street, London, W. C. 2.

Sequoias

On page 392 of the May issue of Natural History is a statement that *Sequoia sempervirens* grows in Sequoia National Park, California. On the opposite page is a beautiful photograph reported as illustrating the same species of tree. *Sequoia sempervirens*, however, is found only along the sea coast. The photograph really shows *Sequoia gigantea*, which does grow in Sequoia National Park.

Samples of dust on exhibit

Recent accessions in the department of geology at the American Museum include samples of dust from Kansas, Colorado, Texas, and Oklahoma. This year's dust storms in the central Great Plains area have been unprecedented, and many farmers have been obliged to abandon their farms. Letters received from correspondents state that many daylight hours have been turned into absolute darkness. In some quarters the dust blew 50 per cent of the time during the months of January, February, March, and April; in the Panhandle of Oklahoma it is reported that there was but one pleasant day in ten.

It is impossible to keep this dust out of the houses, and numerous cases of "dust pneumonia" have developed.

Additional samples of dust are solicited for the exhibit, which is now on view in the foyer of the American Museum. — Chester A. Reeds

The Castillo Cave Model

A small scale model of the famous prehistoric Castillo Cave at the village of Puente Viesgo in the Pas valley of the Cantabrian mountains of northern Spain has recently been installed in the Archæological Hall, Southwest Pavilion, on the second floor of the American Museum.

The model measures 3.5 feet in width by 3.5 feet in height and is 12 feet long. Its frontal aspect shows the position of the cave on the steep slope of the Castillo peak, some 400 feet above the valley floor, and a camp scene staged at the entrance suggests the type of hunting life lived by the occupants just before the cave was abandoned in Late Palæolithic times.

Along the twelve-foot sides of the model, openings are provided to show several interior portions of the cave. Thus, nearest the front appears the partly excavated 50-foot section of stratified culture débris, made up of twelve separate layers as laid down by the prehistoric occupants in the entrance chamber to the cave during an interval of time comprising probably several tens of thousands of years. The culture history represented by these layers is the most complete single record ever discovered and, named in order from bottom to top, includes the Chello-Acheulian, Mousterian, Aurignacian, Solutrean, Magdalenian, Azilian, and Early Neolithic stages.

Directly back of the débris-filled entrance chamber, vacated when standing room failed, a full view is to be had of the "grand gallery," where Palæolithic artists are seen at work making additions to the animal paintings scattered about on the cave walls. This large chamber with a nearly smooth and level dirt floor seems especially suited for dances or other ceremonies which may be supposed to have been performed in connection with the sympathetic magic rituals of which the paintings are thought to have been a part, the purpose being to bring good luck in the hunt of the animals represented.

Still farther toward the rear are to be seen portions of the narrower cave passages leading on for several hundred yards back into the heart of the limestone peak. The proof that early man visited these inky black avenues of the cave is a scattered succession of wall paintings, suggestive of the plant and animal life of that early day. Bones of the same now partly extinct animals, it should be said, are found also in the culture débris in the front part of the cave, so that the time at which the animals lived is certain.

The Castillo Cave was discovered in 1903, and the immense task of excavation was carried out during the decade 1910 to 1920 by Professor Hugo Obermaier, under the auspices of the Institute of Human Palæontology of Paris. During the progress of excavation, the cave was visited by many distinguished scientists from all parts of the world, including Prof. Henry Fairfield

Osborn of the American Museum. Owing to his inspiration, Curator N. C. Nelson of the department of anthropology was privileged to spend part of a summer at Castillo, taking part in the work. It was on that occasion that the necessary measurements and data were obtained for the construction of the model which, with the help of Mr. Nelson, has been executed by Basil E. Martin of the staff of the department of preparation, under the general direction of Dr. James L. Clark and Mr. Albert E. Butler.

Honors

Mr. Clifford H. Pope of the American Museum staff attended the annual meeting of the American Society of Ichthyologists and Herpetologists which convened at Pittsburgh on May 2, and was elected president of the Society for the year 1935–1936, succeeding Dr. Carl L. Hubbs of the Museum of Zoology, University of Michigan.

Dr. James P. Chapin, associate curator of continental Old World birds, American Museum, was honored at the annual dinner of the National Academy of Sciences, April 23, by being awarded the Daniel Giraud Elliott Medal for 1932, and an honorarium of $200.

This honor was conferred in recognition of Doctor Chapin's work entitled "The Birds of the Belgian Congo, Part I," which was published in the *Bulletin* of the American Museum of Natural History, as Volume 65, 1932. It comprised 756 pages and 220 illustrations and maps.

A fifteen-foot whale shark

Mr. Charles T. Wilson, of New York City, a member of the American Museum, has presented to the department of fishes the skin of a fifteen-foot whale shark which he helped capture at Acapulco, southwest coast of Mexico, in March, 1935.

Dr. E. W. Gudger, associate curator, has been studying the whale shark for many years, and when he heard of this capture he got in touch with Mr. Ralph L. Smith of Mexico City, who previously had supplied him with much data on whale sharks from Acapulco. Mr. Smith, acting as agent for the Museum, purchased the skin and supervised its shipment to New York.

When Mr. Wilson learned of the scientific value of this skin and of Doctor Gudger's interest in it, he kindly sent a check covering the cost of the skin and its transportation.

Mr. Wilson's generous action puts the department of fishes in possession of one of the greatest of ichthyological rarities. This is the seventy-seventh whale shark recorded since the first specimen was captured at the Cape of Good Hope in 1828. There is an unmounted skin in the U. S. National Museum at Washington; there are old and inaccurately mounted specimens in the British Museum and the Paris Museum, and others in the Colombo (Ceylon) and Madras Museums. In the Naturhistoriska Riksmuseum at Stockholm, there is a modern mount of a skin obtained at Acapulco in 1934.

A rare tuna

The "dog-tooth tuna," *Gymnosarda nuda*, has a very wide distribution from the Red Sea and Japan across the Indian and Pacific Oceans. It is, however, rarely met with except in remote waters, and is little known to the angling fraternity. Hence, and in view of the present considerable interest in tuna fishing and different kinds of tunas and related large mackerel, an excellent photograph of one taken by the Templeton Crocker Expedition off Pitcairn Island December 29, 1934, on the yacht's trolling line, is worth mention. It was 44 inches long and weighed 43 pounds, which must be nearly of maximum size, and it must have been about at the southeastern edge of its range. — J. T. N.

Changeable colors of fishes

While cruising in Florida waters in April, Mr. J. T. Nichols, curator of recent fishes, American Museum, made some interesting observations regarding the changeable colors of fishes. These are presented herewith:

"Where the Gulf Stream sweeps the east coast of Florida, there is a concentration of many different fishermen, human and otherwise.

"Solemn brown pelicans flap above the waters of Biscayne Bay. Now one turns suddenly down wind and plunges headlong after a small fish. Here and there a black cormorant or white royal tern flies by, and a tall, watchful heron stands in the shallows.

"Beyond the keys the bright green water over the reefs and sand turns abruptly to deeper blue where the bottom dips under the edge of the Stream. Now and then little groups of flying fishes glisten for a moment in the sunshine above the waves, and this is where one finds kingfish, sailfish, and marlin, and the swift, predacious blue and yellow dolphin, with colors so changeable that they defy description.

"The colors of such free-swimming fishes in general are less bold and patterned than those of species which lurk among the coral, and their color changes, therefore less obvious, make detailed and accurate descriptions or reproductions of these colors all the more difficult.

"In the course of one April morning we had several sailfish hooked. As they fought and leaped, their sides shone uniformly bright silver in the sun, but those of one landed were immediately smoky brown. Another time we caught a cero mackerel with steel-blue back, and when a second one was secured a little later we were surprised that its back was bright greenish, the launch without our realizing it having meanwhile run from the edge of the deep blue into the edge of the shallow green water."

Buffalo Museum opens a new hall

A new Hall of Man was formally opened at the Buffalo Museum of Science on the evening of April 4, the American Museum being represented at the function by Curator N. C. Nelson of the department of anthropology.

The unique exhibits there assembled aim to explain the human body as a machine, and consist chiefly of models (of glass, cellon, and other substances), many of which can be manipulated by the visitor so as to show the elementary facts of anatomy and physiology, and incidentally to teach some of the basic lessons of hygiene and sanitation.

The display is the only one of its kind in this country, some of the models being derived from a similar museum in Dresden, while others were designed by the Museum's own director, Dr. Carlos E. Cummings.

Reviews of New Books

Stars, Radio, Travel, Plants, Bird Portraits, and Archaeology

PROGRESS OF ARCHÆOLOGY. *By Stanley Casson. Whittlesey House, New York, 1935, pp. 111, 43 illus. $2.00.*

SINCE the world war, archæology has enjoyed a burst of activity and a popular appreciation beyond anything it had previously experienced. Though no one has enumerated the actual number of field parties engaged in shoveling away the accumulated débris of hundreds and thousands of years, I venture to guess that the post-war annual average would run up to several hundred. With such activity, at almost feverish pitch, it is to be expected that new discoveries of exquisite art, the unfoldings of cultural developments, and the prehistoric connections of vanished people would be announced in bewildering succession. Each new bulletin from the archæological front has obscured its predecessors. Mr. Stanley Casson, therefore, has performed a service of the greatest value by summarizing in brief form the significant advances made in post-war archæology. He has covered the world and the results of scores of diggings in a hundred pages. His account, therefore, is necessarily brief and rigidly selective.

For the specialist this book will be useful for its summary of other fields. For the lay reader, it is a fascinating description of an appealing adventure — the tracing of man's own cultural development. Mr. Casson has sketched the setting and significance of each discovery that he describes so that the reader may follow the progress without a detailed knowledge.

— H. L. SHAPIRO

WHEN THE STARS COME OUT. *By Robert H. Baker, New York: The Junior Literary Guild and The Viking Press, 1934.*

DR. ROBERT H. BAKER, professor of astronomy in the University of Illinois, has written a star book for boys and girls and for grown-ups who are beginning their study of the sky. It is a most attractive volume with its silver and blue cover and a jacket by Artzybasheff. It is copiously illustrated by line-drawings and half-tones, the latter being in blue ink, very appropriate for astronomical photographs. The end-papers show nine phases of the ever-changing moon on the dark blue of the night sky.

Professor Baker's textbook, *Astronomy*, has for years been familiar to college students and teachers of astronomy, and it is an excellent, modern treatise, dealing with the broad scope of the subject from the dawn of the science to the physical tests of relativity. With this in view, it is gratifying to find that the author belongs to that rare group who can turn from his profound studies, and write a book which "not only accuracy governs, but imagination inspires."

We had some idea of Professor Baker's ability to popularize astronomy from his many radio talks on the subject, which have been enjoyed and praised by so many of his countrymen, both young and old. In the book, *When The Stars Come Out*, he has put into permanent, accessible form, his own introduction to a study of the stars, — not technical, but a readable book that will stimulate one to want to know more about the heavenly bodies and their movements, and to achieve something of the satisfaction of understanding the causes of things.

I noted but one slip in the entire book, and that is on page 134 where the distance of the nearest fixed star, Proxima Centauri, is given as "25 million miles," instead of 25 million million or 25 trillion miles.

Like the good teacher that he is, he continually connects the new information or explanation with past experiences. For example: "That is why the moon appears more rugged near the sun-rise line, as we view it with the telescope, and flatter in regions where the sun shines down more nearly directly. As everyone knows who drives a car, rough places in the road ahead look rougher at night when the headlights illuminate them from the side than they do with the sun shining down upon them."

In this book his explanations are always non-technical. In the chapter, which gives the title to the volume, he says:

"It is really the air around us that hides the stars in the daytime. If anyone lived on the moon, which has no atmosphere — so, of course, no one can live there — he could see the stars in full daylight. We cannot see them when the sun is shining, because the air catches the sunshine and sends it down from all directions, flooding the whole sky with a brighter light than the stars give."

When The Stars Come Out is a valuable addition to the juvenile books on astronomy, and will certainly appeal to Boy Scouts, Girl Scouts, Woodcrafters, and members of Junior Astronomy Clubs in these days of revival in interest in the heavenly bodies. — CLYDE FISHER

PLANTS OF THE VICINITY OF NEW YORK. *By H. A. Gleason, Ph.D. Published by the New York Botanical Garden. 1935. $1.65*

HERE is the most compact botanical hand-book that I have ever seen. About five inches wide by about seven inches long and about a half-inch thick, it contains workable keys to all of the ferns and flowering plants found in the territory around New York City. The author states that it includes most of Long Island to the east, and extends as far as the Highlands of the Hudson on the north, the New Jersey mountains on the west, and the Pine Barrens on the south. Except for a few rare species, it will serve well for all the region within two hundred miles of New York City.

It is not intended for the trained botanist, but for anyone else who wishes to learn, by his own effort, the name of any wild flower, tree, or fern growing in the territory about New York.

This is accomplished partly by the elimination of most of the technical terms generally used in manuals of botany, and by defining the necessary ones in a brief glossary. The characters used for determining a plant are almost always those visible to the naked eye. The common name of the plant is placed first, the scientific name being secondary. In short, the keys have been so simplified, and yet they are so carefully worked out that one can usually identify a plant in a very few minutes.

The book is really a *multum in parvo*, and because of this fact should have wide use. The author, Dr. H. A. Gleason, is head curator of the Museums and Herbarium of the New York Botanical Garden, where he has had access to the extensive local herbarium, an indispensable prerequisite. — CLYDE FISHER

BIRD PORTRAITS IN COLOR. *Text by Thomas S. Roberts, M.D. Minneapolis. The University of Minnesota Press. 1934.*

THIS useful book consists of the ninety-two colored plates from "The Birds of Minnesota" by the same author (1932), with a page of text for each plate. Since most of the plates figure several species, the text is necessarily brief, but considerable information about each bird is condensed into the available space. Notes on distribution, habitat, food, habits, nests and eggs, and song are discussed as space permits. Although only the birds found in Minnesota are figured, two hundred and ninety-five in number, there is mention made of many related subspecies from other parts of the country and the book may serve a wide area in eastern North America, outside the bounds of the state of Minnesota.

A brief characterization of each family precedes the account of the species of that family and a comprehensive index lists the birds under various of their vernacular names as well as by their scientific ones.

The plates, by Allan Brooks, Francis Lee Jaques, George Miksch Sutton, Walter Alois Weber, Walter J. Breckenridge, and Louis Agassiz Fuertes are rather unequal in quality and some of the colors have not been reproduced with perfect accuracy (as for instance in the crown of the ovenbird); but the average is high and the series in general presents excellent portraits of the species represented. Seasonal, sexual, and developmental variations in plumage are given more than usual attention, which fact adds much to the value of the pictures. Comment on the plates, however, belongs properly in a review of the larger work where they first appeared.

Although too large for the pocket, the volume is slender and can find a place in the equipment of many excursions where it should be useful as an aid to the identification of the birds. — J. T. Z.

RADIO ROUND THE WORLD. *By A. W. Haslet; Cambridge University Press, London; Macmillan, New York; Marusen Company Ltd., Tokyo, 1934, 8 vo. $1.50.*

THIS little book of 196 pages gives the history of radio transmission and explains many a puzzling problem concerning radio waves, which are of special interest to the radio amateur, engineer, physicist, geologist and astronomer, and of general interest to the radio listener.

Those individuals who possess a radio, or listen to one, and that includes most people in the civilized world, marvel not only at the small instrument with its complex of wires, condensers, tubes, etc., but at the clearness of its reception, its range and the delight it affords of a direct communication with a distant station. When the program does not suit our taste, how easy it is to turn the dial to another position and receive a different program, or change the coils and listen to London, Paris, Madrid, Berlin, Caracas, Guayaquil, or Buenos Aires.

Not infrequently we hear radio announcers speak of "a nation wide hook-up" or of one broadcasting station asking another to "stand by" or "take it away," as when New York is calling "Little America" at the Bay of Whales, Antarctica.

Whether the message is received through a series of relay stations or direct by short wave set, we marvel at it all, and wonder how it is possible. Sometimes the reception is not good, and we immediately ask why it is poor. This little book explains these features and tells you how it is possible for New York to communicate by air with "Little America" ten thousand miles away or for London to talk with New Zealand.

This book also tells you that the radio wave is like light yet different, and how it gets around the world. It demonstrates how its power waxes and wanes in daytime and at night, in winter and summer, and during the sun's slow cycle of changing activity. It explains the Heaviside and Appleton layers which not only appear high in the atmosphere, but change their positions in the course of the day and serve as "mirrors" for the reflection of radio waves as they are transmitted through the air. The sun's ultra-violet rays and their effect on wireless conditions as well as the absence of these rays during a total eclipse are also discussed. Mention is also made of the effect of intense magnetic action caused by the appearance on the sun's surface of sunspots. This phenomenon is cited as being responsible for two periods of silence in the radio communications with General Nobile during his Polar flight in the ill-fated airship "Italia."

It also states that man cannot hope to abolish atmospherics, and explains the why and wherefore of this phenomenon. It discusses, too, the great problem of fading, and the use of "ultra short" and "micro" waves in practical radio, such as television and the treatment of disease. The radio beacon and direction finder, which are serviceable to ships and airplanes at sea, as well as the use of radio in weather forecasting, and the significance of the radio valve or tube, receive due consideration.

In fact, this book gives us the why and wherefore of radio, which is of no little interest in this age of radio achievement. — CHESTER A. REEDS

HANDBOOK OF TRAVEL. *Prepared for the Harvard Travellers Club. Edited by George Cheever Shattuck. Second Edition, Revised and Enlarged. 510 pages, 16 figures, and inserted graphic table. Harvard University Press, 1935.*

INCREASING mobs of thoughtless tourists invading regions that were utter wilderness a generation ago do not alter the fact that there are still large numbers of thoughtful travelers and many out of the way places for them to visit.

This handbook, originally published in 1918 and now so extensively rewritten as to be essentially a new book, is primarily addressed to those who travel beyond the reach of train and liner schedules and to those who wish their journeys to be useful and intelligent, wherever they may go. The modern explorer, a professional thoroughly trained for a specific scientific task, will need no such assistance in his own field, but he, too, can profitably turn to the handbook for guidance in planning work in regions new to him or for making supplementary observations outside his own specialty.

As in any work by numerous authors — there are thirty-nine in this case — the quality is uneven. The chapter on llama transport appears to break the rule, otherwise well followed, that the author have personal knowledge of his subject. The omission of any consideration of map-reading is striking, and there is no helpful reference to simple compass traverses, sketch mapping, and similar operations within the powers of the average traveler and often essential to him. On the other hand, an elaborate instrumental traverse is outlined, involving the use of bulky, expensive, and delicate apparatus, beyond the powers of any but a trained surveyor (who would not turn to this work for this information), and necessitating the organization of a party definitely for surveying. At the other extreme, the section on reindeer transportation is equally out of place in the handbook, being a personal travel tale with only incidental reference to reindeer and of no conceivable assistance in making plans. Such failures to record just the sort of information that will be sought in the handbook are, however, few, and the whole work is competent, most of it excellent.

Procedures and precautions

The discussions of means of travel, forming the first section of the book, include almost every known means of transportation from walking to airplanes, with the obviously justifiable omission of trains and ocean liners. In most cases the information given is sufficiently explicit and full to permit anyone to plan his transportation intelligently and, what may be more important, to keep it going, witness, for instance, the valuable notes on preventive and curative care of pack animals. There follows a section on camping, with discussions of tents, clothes, and all sorts of camp equipment and supplies, as well as notes on hunting, fishing, and edible wild plants.

The information on photography is sound and so well condensed that it includes more that is actually useful in the field than do most manuals of photography. References to miniature cameras are accurate, but seem unjustifiably lukewarm. In the reviewer's opinion, these are the ideal cameras for just the class of traveler that will use the handbook.

The sciences of travel, geography, geology, zoölogy, botany, anthropology, and meteorology, are all ably discussed from the point of view of enabling the amateur to make original observations and collections. The importance of such work can hardly be overemphasized. At the least it adds purpose, interest, and comprehension to any traveling, and it may result in discoveries of real importance. Furthermore the planning and direction of detailed, professional scientific work depends to a larger extent than is generally realized on indications originally received from travel for other purposes or for recreation.

Most of the section on hygiene, surgery, and medicine is by the editor and it ably condenses into little more than a hundred pages all the precautions and procedures that are likely to be useful to a traveling layman and that he could safely carry out.

Almost all the chapters include bibliographies and references to more extensive and detailed information on the same subject. In a few instances, for example geology and geography, reference is to texts much less useful in this connection than would be available field books that are not mentioned, but most of the references appear to be well chosen. The handbook may well take its place as the coördinating volume of a practical travel library. Printed on thin paper in a convenient format, it is adapted not only to assist preparations for a journey but also to go along as a guide and companion in pocket or travel kit. — G. G. S.

DIARY OF THE ALARCÓN EXPEDITION INTO TEXAS, 1718–1719. *By Fray Frencisco Céliz. Translated by Fritz Leo Hoffman. The Quivira Society, Los Angeles, 1935. pp. 124. plates X.*

IN 1933 the diary of Alarcón's expedition to Texas was discovered, buried by inaccurate filing, in the Archivo General de la Nación in Mexico City. The account deals with an expedition dispatched to the present Texas, principally to discourage French expansion and secondarily to report on the character of the country. Alarcón fulfilled his mission successfully. Setting out from the Rio Grande he reached the San Antonio River where he established the present city of San Antonio. He traced the source of the Rio Marcos, explored the coast in the vicinity of Espiritu Santo, and advanced eastward almost to the Red River.

The diarist narrates an unadorned anabasis full of river fordings, religious celebrations, and the bestowal of holy names on unholy reaches of territory. It is to be regretted that he did not have a deeper interest in the Indian, for the opportunity was offered him to record what has long since been irretrievably lost, — the life of the savage. Nevertheless, the casual mention of various tribes is of value.

Alarcón's expedition makes an interesting footnote in the history of the Southwest. — H. L. SHAPIRO

Recent American Museum Publications

NOVITATES

No. 788. African Muscidae. — III. By C. H. Curran.
No. 789. Two New Genera of Cricetid Rodents from the Miocene of Western United States. By Albert Elmer Wood.
No. 790. Taxonomic Notes concerning Arvicanthine Rodents. By Robert T. Hatt.
No. 791. Four Hitherto Unrecognized Subspecies of African Rodents. By Robert T. Hatt.
No. 792. Spiders from the Southwestern United States, with Descriptions of New Species. By W. J. Gertsch.
No. 793. Descriptions of the Oldest Known South American Mammals, from the Rio Chico Formation. By George Gaylord Simpson.
No. 794. Further Notes on American Lycosidae. By W. J. Gertsch and H. K. Wallace.
No. 795. The Tiffany Fauna, Upper Paleocene. I. — Multituberculata, Marsupialia, Insectivora, and ?Chiroptera. By George Gaylord Simpson.

BULLETIN

Volume LXVIII, Art. 4. Wallace's Line, and the Distribution of Indo-Australian Mammals. By Henry C. Raven.

Recently Elected Members

A report from the membership department lists the following persons who have been recently elected members of the American Museum:

Patron

Miss Susan P. Carr

Life Members

Messrs. Robert Le Moyne Barrett, Joseph M. Hartfield.

Sustaining Member

Mrs. Harrison Eustis.

Annual Members

Mesdames Baldwin Browne, Gertrude E. Case, E. W. Eager, Gladys Gordon Fry, James T. Harrington, Amelia Kurash, H. C. Marks, Elizabeth R. Merseles, Francis L. Noble, Walker E. Swift, Alma M. Vail, John C. Vander Pyl, John Jay White, Lucius Wilmerding.

Sister Assumpta Maria.

Misses Adele Buchsbaum, Ella Huntting, H. Kelly, Hermione R. Ketcher, Barbara Landis, Elizabeth McCalmont, Helen B. Russell, Helen Wheeler.

Rabbi Irving Miller.

Doctors Sidney Cohn, M. Downey, T. B. Enders, A. B. Muir, Henry J. Schireson.

Messrs. Henry B. Adriance, Marston T. Bogert, Anthony Bonura, Robert Livingston Cahill, L. Sprague de Camp, G. Edward Delano, Jr., William Etkin, John J. Finuchene, Ardo Hering, Walter M. Langsdorf, William B. Loery, Edward C. Lord, John R. MacArthur, Beverly A. Norris, R. B. Ray, Samson Rosenblatt, Leo Silverstein, Maurice M. Sternberger, Vance Stewart, John D. Thees, Jr., Saul Weil.

Associate Members

Mesdames Dwight Akers, Charles S. Aldrich, Eva B. Alper, E. G. Armstrong, Carrington G. Arnold, Carlos Dale Aseltine.

Lillian S. Bach, Grace Harris Barber, Roswell P. Barnes, Warren S. Barnum, Maggie W. Barry, S. Westray Battle, Daniel Beckwith, Lewis D. Bement, Watson H. Bettes, W. R. Bishop, Graham B. Blaine, Oscar Bloch, Emma H. Bluhm, Rita M. Bolger, Russell G. Booth, Anna C. Bostwick, C. C. Bovey, Eugene W. Bowling, Harvie Branscomb, Ramona B. Breese, Joseph W. Brooks, Burton Brown, Edward O. Brown, H. E. Brown, Nathaniel Paige Brown, Carrie G. Bunzl, Clara M. Bush, Jeanne N. Bush, Howard Russell Butler, P. H. Byrns.

Anna B. Callahan, Harrison H. Camp, Ruth Orton Camp, Olive D. Campbell, Laura Carey, Rubie Helen Carmichael, John N. Carothers, J. F. Carpenter, H. W. Carreras, A. L. Casseday, Eugenia O'Connell Cerio, V. J. Chambers, L. H. Paul Chapin, Floyd E. Chelf, Edward O. Christensen, Abigail E. Clark,Margaret Claussen, McGarvey Cline, Edmond D. Coblentz, Whitney Coleman, Lenora A. Collingwood, A. W. Connor, Marjorie B. Cooper, William E. Cortelyou, George F. Covell, E. A. Cox, Beatrice Craig, Anna M. Curless, Richard D. Currier, Stanley G. Curtis, Leslie B. Cutler.

Elizabeth Ward Dailey, Laurence E. Davies, Edward S. Denton, Kathleen V. N. Depue, James A. Diffin, Arthur M. Dole, Blake F. Donaldson, Louise Quinn Donovan, T. G. Douglas, Henry Drought, Frances Dunworth.

M. Belle Ecklund, Frank Evans.

Bernard C. Feenan, Maud D. Ferris, Agnes D. Fineman, Hopkins Ford, Daisy A. Houck, Elinore Brown French.

A. W. Galloway, Agnes Gardner, Edith L. Garrigan, Dorothy J. Geddis, William B. Gere, Carrie V. Stephenson Gibbs, Elinor C. Giddings, E. H. Goins, H. H. Goldner, Paul C. Good, Jessie B. Gordon, H. L. Gormley, Caesar A. Grasselli, 2d., M. Green, Grayce Greenburg, Audrey F. Griner, Jennie Burroughs Groh, Kurt Grunwald.

Esther Fiske Hammond, Kenneth R. Hare, Nan Cox Hare, Florence Clarke Harris, John H. Harris, D. M. Harriton, Edward Everett Hayden, R. B. Hearn, S. K. Henry, Fannie G. Hirschhorn, Lydia B. Hogan, E. S. Holbrook, Carl Holm, Sam C. Hopkins, Cecil P. Hostetter, Louise C. Howard, Christian P. Humer, C. L. Hussey, Helen A. Huston, Catherine E. Hyde.

Clyde E. Ingersoll.

Ida G. C. Jackman, L. E. Jenkins, Charles B. Jobes, Ruth Bryan Johnson, Alexander Jutkovitz.

Theresa H. Kananack, Gladys B. Kennedy, Ethel E. Kenson, Lyndon M. King, John T. Knight, Simon Kuhn.

Geo. B. La Boyteaux, Edith N. Lewis, Johanna M. Lindlof, Richard L. Livermore, T. B. Lloyd, H. N. Lockwood, Arthur Loesser, Clarence B. Long, Henry W. Louria, John M. Lynch.

J. N. Macy, Bessie Mansfield, Lucile Rogers Marshall, Effie H. Martin, Everett D. Martin, Isabelle C. Mathis, Lela Bonner McCallum, Susie Lawson McCrea, Eva D. McIntosh, George B. McKibbin, Edith M. Michaels, Elmer E. Miller, Fred L. Miller, Reydonia Miller, Ruth A. Ming, D. W. Moffat, Marcel H. Moisson, Helen A. Moldstad, Marie M. Monosmith, C. A. Moore, Elizabeth C. Moore, William H. Moore, Theodore C. Morehouse, H. M. Morse, E. G. Mosle, Ralph M. Munroe, J. Edgar Murdock.

Edith Meigs, S. Napier, Grace D. S. Nichols, H. J. J. O'Neill.

Mary Logan Orcutt.

Adelaide Parker, T. S. Parker, Lillian C. Parkes, Stanley Patterson, E. V. Pearson, W. S. Perham, Gertrude M. Perkins, Clare Griffin Perry, A. L. Postle, Michael Price, Wm. Pupke.

Mary E. Quinn.

Marjorie Kinnan Rawlings, Henry S. Redmond, Florence Beebe Reeve, R. W. Riley, Evelyn C. Ritchie, W. W. Robertson, Malcolm B. Rook, Alice C. Ross, Robert Bruce Roulston, Charles Rudd, Daniel Carver Russ, H. G. Ruth.

Kenneth Shaw Safe, Conway Sawyer, Rebecca P. Schaeffer, Tamar A. Scholz, Frederic E. Schluter, Alice H. Segersten, Kathryn C. Seghers, Eloise S. Seltzer, Chester R. Seymour, William G. Simplon, Jr., Catherine Simpson, Stella J. Sims, John Sise, Eleanor Clarke Slagle, Harriet L. Slater, Annie Currey Slawson, B. G. Gordon-Smith, Henry Clapp Smith, Florence H. Soule, Mark Speaker, Elias Spear, C. M. Staples, D. S. Stayner, Roberta Graham Sterrett, Harry B. Stitt, Marie Stolberg, Lillian A. G. Sullivan.

Leslie R. Taber, A. R. Tardelli, Howard C. Taylor, Jr., Walter L. Taylor, Edward H. Temple, S. Camille Tenney, Esther T. Terry, T. C. Thayer, Blanche K. Thomas, Francis W. Throop, Bell M. Tilghman, Henry W. Tillinghast, Sarita Romero Tjoflat, James M. Todd, John R. Todd.

Ira Amon Updike.

H. Margaret Van Nostrand, Robert Ferguson Vaughan, Alice Vining, John Vodermaier.

William A. Wachenfeld, Albert B. Wagner, Harriet B. Wagner, Edward A. Waldron, H. D. Walker, Anna J. Walsh, Joseph B. Walters, Laura R. Warne, Edwin Wasser, George Wattley, G. P. Weaver, Homer D. Wells, W. J. Wells, P. E. Westover, Robert L. Wheeler, John J. White, Sr., J. Reese White, Arthur James Wieland, Edgar Swan Wiers, L. L. Williams, Margaret C. Williams, Gladys H. Wilmott, Andrews C. Wintringham, William Roy Wolf, Florence M. Wolford, Henry Newbold Woolman.

Edythe A. Yeager, John E. Zimmermann.

Misses Elizabeth Adelson, Mildred M. Ahlem, Virginia Allen, Virginia Andersen, Ruth V. Angelo, Mildred M. Angle, Marion F. Anthony, May R. Averill.

Lucy Babsky, Julia Baker, Beverly Balch, Agnes Ballard, Corinne M. Barker, Jean Barrie, Amy Bartholomew, Sophia Bartosek, Alma A. Bauer, Lauretta Bean, Louise M. Beck, L. M. Beckbissinger, Vida M. Belk, Doris H. Bell, Evelyn L. Benagh, Hilda M. Bender, Lillooet Bent, Jean Berger, Gertrude Bernstein, Ethel M. Bidwell, Elizabeth Biles, Georgia E. Billings, Mary Bishop, Ruth Bishop, Hattie Mae Bittel, Esther M. Bjorland, Bessye K. Blaufarb, Helen H. Blish, Marjorie Bliss, Mary Blosser, Emily E. Boggs, Anna M. Bohl, J. Gertrude Bonham, Helen Elizabeth Bowen, Alida C. Bowler, Nancy F. Bowman, Amy L. Boynton, Ethel C. Bratton, Laura E. Bremner, Dorothy J. Brewer, Dorothy Brooks, Helen M. Brown, Phyllis Brown, F. May Bullock, Louise Burford, Mary Burgess, Helen E. Burnhill, Gladys A. Burns.

Christine Caldwell, Bess Callahan, Irene B. Canning, Ellen L. Canton, Grace B. Carpenter, Frances Marie Carroll, Madeline E. Chambers, Elizabeth G. Chapin, Alice G. Chapman, Anna Evelyn Chasen, Ann Chatham, J. Louise Chick, Maxine Chrisman, Bertha Elizabeth Church, Christine Churchill, Helen M. Clark, Virginia Catherine Coan, Genevieve K. Connolly, Katherine Constantine, R. Mildred Cooper, Frances Coppens, Marilyn L. Corcoran, Margaret M. Cornelsen, Elsie L. Corner, Fern Cory, R. Margaret Crabb, M. Virginia Craig, Louise Mason Cramp, Elizabeth Cutler.

Edith Manville Dabb, Meta Caroline Daniel, Isabelle J. Davidson, Harriet P. Davies, Eugenia Vreeland Davis, Marie L. Davis, Lanie C. Dearson, Alice Brennan Deckman, Dorothy Dedrick, Elizabeth Henrietta Dee, Louise de Ginther, Susan Elizabeth Demery, Jessie F. De Shong, Lillie Detrick, Beth Deyoe, Anna T. Digney, Mary Virginia Dinwiddie, Alice Dombrowska, Marguerite Douglas, Olivette Lenice Douglas, Gladys Downing, Hertha Dreher, Marguerite P. Drew, Margaret G. Dudley, Anne G. Dunetz, Evelyn J. Dunlop, Aurelia Dunstan, Zara du Pont.

Bertha Marston Eckert, Leonora Ehrenberg, Irma Eichenberger, Janet Maxine Ellicott, Elsie B. Ellis, Sallie S. Ellis, Florence Jordam Emery, Catherine J. English, Jeanne A. Ernst, Lily M. Ernst, Dorothy Marie Espenlaub, Charlotte E. Estes, Alice J. Eustis, Mary Ewing.

Ida C. Falck, Barbara D. Falkner, Mary R. Falvey, Frances M. Ferguson, Emilie L. Fiero, Rebecca Fine, Elizabeth T. Fitzpatrick, Helen Flanagan, Lee Forney, Kathryn Fowler, Beatrice Frye, Margaret Fulford.

Beatrice Lucia Gale, Eugenia K. Gallo, Helen M. Gates, Henriette C. Gehrke, Grace Geiger, Louise C. Gent, Millicent Geoghegan, Evangenline Gerard, Dorothy Getz, Martha Ellen Gilbert, Gladys

Rose Gillespie, Helen Gilman, R. L. Girard, Katharine E. Gladfelter, Florence Gold, Josephine Goldberg, Dorothy M. Golden, Lillian R. Goldwyn, Peggy E. Goodman, Margaret D. Goodwin, Eleanor P. Gould, Marion A. Greene, Willie Greene, Vera Greenlaw, Marion Gregory, Mary Eleanor Guerin.

Frances Hall, Florence M. Hallam, Jane Harris, Zida H. Harris, Laura Estelle Hartge, Marion Hepworth, Lillian Hettich, Alberta Hiester, Lora Hilyard, Anne H. Hinckley, Alma Holbrook, Charlotte K. Holbrook, Ruth E. Hollingsworth, Katherine Hook, Dorothy Hopper, L. Frances Howard, Mary Louise Hulbe, Lucille M. Hummelgard, Anna M. Hunt, Mildred Briggs Hutchins, Mary E. Hutchinson, Sally V. W. Hutchinson.

H. A. Iler, Florence Carolyn Ita.

Eliza Garretson Jackson, F. Jackson, M. E. Jansen, Louise Jensen, Augusta Johnson, Ethel E. Johnson, Rae E. Johnson, Lettie L. Johnston, Ethel Jones, Maude K. Jones.

Irene C. Kearney, Cecilia A. Kendler, Margaret A. Kennard, Mary Nell Kilgo, Ruth Klein, Helen Knight, May K. Kraus.

Marjorie Lalor, Katharine C. Land, Julia A. Latula, Mary Bradford Laugheady, Frances R. Layes, Genevieve Lee, Virginia Lee, Mary Leininger, Catherine Linke, Marian W. Little, Mary E. Lodge, Eugenie L. Loos, Caroline L. Losche, Marian Lundgren.

Edith L. MacCormack, Carrie L. Macgerald, Rosemary A. Maguire, Rose E. Maloof, Amelia C. Mandabach, Dorothy Elder Marcus, Molly Margolis, Lucile Marine, Frances Marion, Agnes M. Marshall, Florence Martin, Alexandra Matheson, Miriam C. Matsen, Vlema Mattice, Ida J. Matz, Julia Lippitt Mauran, Lucy McCuen, Mary McCullough, Elizabeth McDonald, Margaret E. McDonald, Willie Ray McDonald, Harriet McFadden, Lydia McIlvaine, Irene F. McKeever, Mary Maude McKenzie, Charlotte I. McKinney, Marcia McNee, Edna C. Medjo, Marion Mendelsohn, Lina D. Miller, M. Thelma Miller, Lois L. Mims, Viola Moran, Bess Morris, Clara L. Morrison, Rose H. Morrison, Edna Mosher, Hope Mowbray, Catherine Jane Murphy, May Convery Murphy, Regina H. Murphy, Mary F. Murray.

Phyllis Louise Neale, Alice A. Neukamp, Ruth Norton.

Abigail O'Brien, Marie M. O'Connor, Ruby M. Odell, Mary O'Donnell, Norine O'Rourke.

Robin Palmer, Grace A. E. Paterson, Evelyn Peavy, Elsie V. Pendleton, Helen Gladys Percey, Mary M. Perkinson, Elizabeth I. Perrin, Maude Caldwell Perry, Lillian Peschek, Louise A. Pfluger, Rosa Phillips, Jeannie M. Pierce, Beatrice Amelia Pinto, Gladys R. Piper, Carol M. Pitts, Mertie A. Postel, Margaret M. Pratt, Ellen B. Pray, Martha F. Price, Georgia Pruitt, Annie W. Prunotto, Helen Prunty.

Ella M. Rafuse, J. Grace Ramsay, Ida Ramey Ratliff, Eleanor Morse Rawson, Beryl I. Ray, Mary L. Reilly, Della F. Reitz, Louise R. Reutemann, Katharine N. Rhoades, Clara A. Richards, Marion C. Richter, Cathryn V. Riley, Eda M. Rizzie, Dorothy Rodger, Mary X. Rogan, Claribel C. Rogers, Mary Barlow Rogers, Miriam Rosenberg, Mildred Rountree, Anna Ruppel, Mary E. Russell.

Constance H. Samuel, Linda Wanda Schelling, Jacobine F. Schierenberg, Emily Schoenberg, Pauline V. Schreffler, Evelyn E. Schuster, Bessie R. Schwartz, Mary L. Schwartz, Jeannette Seligmann, Patricia Ann Seyko, Lorette A. Shaughnessy, Martha T. Shaughnessy, Carrie V. Shaw, Laura Emily Shaw, Doris E. Sheafe, Charlotte Sheridan, Darline Shewell, Alma E. Shimer, Florence Ethel Shulman, Marianna Shutes, M. Lois Simons, Olga L. Slavik, Jane Sloyer, Mary Lovett Smallwood, Harriet Ballou Smith, Vera I. Smith, Virginia LaRene Smith, C. Mildred Snyder, Jennie Sokoloff, Estelle S. Solon, Harriet Sommer, Melvina Sorrento, Alice Dean Spalding, Myrtle Spaulding, Mary Inglis Spilman, Anna Laura Staples, Harriet Starin, Helen W. Steck, Gertrude Steffen, Ruth Stewart, Catherine Stokes, Anna K. Stolson, Annie M. Strang, Eva F. Straus, Stella G. Streeter, Ruth Lee Sullivan, Emma F. Summerhill, Verna Rumelhart Sumpter, Annie Sutherland.

Alice Claxton Taggart, Jane I. Taylor, Joan Taylor, Maria Tea, Wilhelmina Tenney, Alice B. Thompson, Flora M. Thurston, Catherine A. Tinkham, Nancy Townsend, Dora May Trexler, Malvina Trussell, Marie A. Tucker, Alice Root Tutelman.

Elizabeth Underwood, Frida von Unwerth.

Katherine T. Valentine, Eleanor V. N. Van Alstyne, Euphemia C. VanHolland, Jennie L. Van Wyck, Dora N. Varin, Agnes Voit, Hazel Annette Voshall.

Louisa C. Wagener, Jennie Walker, Agnes Wall, Ailsa Norah Ward, Florence Webster, Elsa Weihl, Catharine M. Wellington, Leonora C. Wenigmann, Dora E. Wetterhahn, Ethel Marion Weymouth, Clarissa E. White, Edythe White, Gertrude B. Whittemore, Lela M. Wickham, Elsie J. Wiesner, Rosalind Wiggins, Grace William-Jorgensen, Augustine Williamson, Mary E. Wilson, Acacia Jean Wing, Marguerite Winstead, Helga Wolski, Josephine Woodlock, Leah Woolley, Harriet M. Wraight, Laura Wuennecke.

Doris Zalkind.

Reverend Doctor J. H. Horstmann, Edward McCrady.

Reverends B. I. Anderson, Francis Bolek, C. L. Browning, R. A. Foster, Buel C. Horn, John W. Hoyt, Anton E. Jensen, Paul E. Kean, Standish MacIntosh, James J. Mentzer, William S. Noble, S. Joachim Ryder, Alphonse M. Schwitalla, Louise Tahse, J. G. VanDyke, Gordon S. Vincent.

Rabbi Beryl David Cohon.

Brigadier General Chas. A. Smart.

Captains Delbert Brunton, Thos. H. Christian, U.S.A., Wm. T. Dillon, U.S.A., Paul Horgan, Edward C. Venetianer.

Lieutenant Commander Leland P. Lovette, U.S.N.

Lieutenants Samuel Rubin, William J. Walker, Henry M. Zeller.

Sergeant Joseph F. Murphy.

Doctors C. J. Amble, Charles A. Anderson, D. Murray Angevine, R. Elsie Arbuthnot.

S. Luther Bare, Harvey Bartle, W. A. Barton, Jr., Roy L. Beadles, Richard Olding Beard, G. Wesley Beatty, Martin C. Beilke, Henry W. N. Bennett, John A. Benvenuto, Frederic Bierhoff, Samuel J. Bloom, Erhard Boetzel, Bernard H. Booth, Russell S. Bray, Harold K. Brigham, Hugh Alan Briscoe, Robert O. Brown, Judson Frederick Browne.

Bertha Chapman Cady, Lorne A. Campbell, Louis Carp, George Byron Carr, Henry W. Champlin, Leland Chapman, Harry L. Clark, E. H. Clauser, Harry Cohen, Mary W. Colley, Annunziato Condo, Joseph L. Conrad, M. E. Thompson Coppin, Herbert J. Corbett, Leon C. Cote.

William Dameshek, Donald G. Davidson, C. Lindale Davies, John S. Davis, James DeChristoforo, William Drayton, Jr., M. E. DuBissette, John J. Dumphy, L. C. Dunn, F. Duran-Reynals.

Julian G. Ely, C. S. Ruth Engelhardt, Charles Englander.

Albert S. Fay, Hermann Feit, Joseph J. Feminella, Raymond Fessenden, Irving E. Fink, Saul Freedman.

Conrad K. Gale, Percy B. Gallegos, Martin F. Gaynor, William E. Gazeley, I. J. Gelb, Henry Gibbons, 3d., William C. Gibson, Wm. V. Gilbert, David R. Goddard, Robert Good, Robert W. Gover, Harry S. N. Greene, William Gribow, Oliver K. Grier, Loren Guy.

J. P. Hadfield, Charles Haines, E. Everett Hamilton, Margaret J. Hamilton, M. Coleman Harris, Howard A. Hartman, Jerome Hartman, Mason A. Hawkins, Rudolf Heinemann, Robert T. Henry, David S. Herman, John Herrlin, Houghton Holliday, Bernhart Paul Holst, V. E. Holt, G. Herbert Hooper, John Horn, J. Shelton Horsley, Mark Hornstein, Warren D. Howe, Edward Lee Howes, Willis N. Huggins.

James Hebry Inkster.

H. P. Jacobson, Gerald R. Jameison, H. A. Jarre.

P. Jorda Kahle, Norman M. Kerr, Franklin L. Kessler, John E. Kiley, Robt. Washington King, Herman Kleinman, Walter O. Klingman.

Phil. S. Lansdale, Tiffany Lawyer, Julius Lemelson, Louis Lesser, Edwin L. Libbert, Herbert T. Liefeld, Fred O. Lien, George G. Lindsay, Oliver W. Lohr, E. N. Boccanegra Lopez, M. J. Lossow, Laurence J. Louis.

Horace G. MacKerran, Russell G. MacRobert, M. O. Magid, E. Wasgate Markens, Roy D. McClure, Theo. E. A. McCurdy, Douglas Barton McDowell, J. P. McQueen, Joseph Melton, A. J. Mendelsohn, Chas. S. Miller, Charles W. Mills, Virginio Minervini, H. O. Miranda, S. Miyasaki, Howard Moore, Joseph S. Murrin, Frederick W. Muth.

Willard L. Nash, J. M. Nealon, C. L. Noack, Rudolf J. Noer.

James P. O'Brien, Michael J. O'Connor, Logan S. Owen.

Hector A. Landaeta Payares, A. M. Pernetti, James C. Perry, William Bryant Perry, Harry T. Pessar, Geo. A. Pettigrew, Norman J. Pfaff, John Woodward Pierce, Samuel D. Piquet, R. K. Pomeroy, William Porter Pratt, Francis I. Proctor.

L. H. Redelinos, T. C. Redfern, George F. Reusch, David Robinson, S. Robinson, Alvin S. Rogers, Harry Rogers, Joseph J. Romano, Maurice Rona, Solomon P. Rosenthal, Ralph H. Ruggles, W. Ruml, Edward P. Ryan.

Edmond F. Sassin, Henry S. Satterlee, W. G. Saunders, Louis Schneider, A. W. Schoenleber, Max J. Schroeder, M. P. Schultz, Hiram Sidley Schumacher, D. H. Scott-O'Connell, Gotthard E. Seyfarth, W. G. Shallcross, Henry Alden Shaw, T. P. Shearer, Cleveland S. Simkins, Jibran Y. Skeirik, Adela J. Smith, Philip E. Stamatiades, Guy Beckley Stearns, George Whitfield Stephens, A. B. Stewart, Howard A. Streeter, Edward H. Sutliff.

John B. Talmage, David Tanchester, Daniel Thron, Hans Tretter, Frank A. Trippe, F. A. Troie, Philemon E. Truesdale.

J. C. Vinson, Anne Harvey Voorhis.

Charles F. Warren, W. G. Watt, Milan J. Webster, Frederick R. Weedon, Samuel Z. Weinstein, S. Theodore Weiss, Guy W. Wells, R. E. Westmoreland, H. B. Wilson, S. C. Wilson, Wilfrid D. Wingebach, C. C. Wolcott, Tryphosa R. Worcester, Ethel Emerson Wortis.

Claude Youtsey.

Moses Zalesky, Alfred A. Zangrilli.

Professor Doctor S. L. van Orden.

Professors Harrison S. Elliott, L. F. Graber, J. F. McClendon, Ernest S. Quimby, Louis Agassiz Test, Ellis Thomson, Charles L. Trabert.

Judge Herbert M. Schiller.

Honorable Vernon Gates.

Messrs. George L. Abbott, Walter J. Abel, Charles E. Ackerman, Alfonza Adams, George A. Adams, J. Harold Aiken, C. K. Albertson, Henry F. Alderfer, Edgar S. Ale, Robert C. Alexander, Walter N. Alexander, George Alk, John Allan, Frank C. Allen, G. W. Allen, M. C. Allen, Richard W. Allen, Harold Leslie Allsopp, G. N. Alvord, Russell O. Alvord, George A. Ambrose, Coleman E. Andel, Martin Perry Andersen, Malcolm Annadale, Wm. Howland Applegate, Jr., D. V. Archbold, Jorge Bird Arias, I. B. Armstrong, Edgar Arnett, J. Leroy Arnold, R. H. Atterbury, Will G. Atwood, Louis Auperin, O. H. Aurand, John H. Aydelotte.

Orville Gorman Babcock, F. J. Bagocius, E. Nourse Bailey, Frank W. Bailey, Austin J. Baird, H. Virgil Baird, W. C. Baird, Charles I. Baker, George A. Baker, Anderson Bakewell, Thomas M. Balliet, Philip R. Barbour, Eugene S. Barclay, 2d., Amos F. Barnes, John E. Barr, Henry Clay Barrett, David D. Bates, William R. Bauer, Harry R. Baxter, W. D. Bay, Charles Dudley Bayne, Albert E. Baze, Walter W. Beattie, S. A. Beck, Elmer F. Becker, Wm. S. Bedal, Louis F. Bein, Thomas P. Bell, Edward P. Benjamin, Richard E. Benjamin, John H. Bennett, Ralph Benton, Norbert H. Berens, Robert Allan Bernhard, C. Bethel, Lynwood K. Betts, John W. Biggy, James Claude Billingslea, C. A. Bills, Robert A. Billstein, Walter A. Bilotta, Isidore Biltchik, Geo. Birnbach, H. J. Blackford, M. Lucien Blancou, Ralph Block, W. G. Blocksidge, Geo. H. Bohnen, Robert P. Bollinger, Elon H. Bomberger, Elwood P. Bonney, Leslie A. Bonne, A. Allan Booth, Edward C. Bowen, Arnold Bosman, Robert Lee Boyd, Clarence E. Boyer, George N. Brace, Vivian R. Braddon-Walker, Maurice A. Brandt, W. C. Braun, Charles O. Brawdy, Harold S. Brecht, Russell P. Brewer, Earl L. Brewster, Robert E. Brien, Floyd E. Brink, Bennet B. Bristol, Herbert T. Britten, John J. Brodhead, Curtis N. Brown, Lee M. Brown, Arthur T. Browne, Raymond Bedell Brownlee, Alex Bruenn, Edward J. Brundage, Philip D. Bryan, Edwin James Bryant, J. A. Buchanan, W. Bayard Buckham, Thomas F. Budlong, Walter Q. Bunderman, Alfred E. Bungay, Norman A. Buras, Henry O. Burdette, J. M. Burk, Harry R. Burke, J. James Burke, Henry A. Burmeister, B. F. Burns, H. P. Burton, Ronald Burton, Howard Baldwin Busfield, Earl C. Butler, J. P. Byrd, Jr.

John Caffey, Robert W. Cairns, Wade Calavan, Tyler Calhoun, Brinton M. Cameron, J. Russell Campen, C. Lester Cannon, John Whit Capel, Billie Carey, R. P. Cargille, C. L. Carle, Douglas Carmichael, Oliver C. Carmichael, C. H. Carpender, Lee B. Carr, Joseph P. Carson, Jr., Raymond L. Carson, Frank Cartwright, Clarence E. Case, H. W. Chadbourne, Edmund K. Chaffey, Joseph Chapman, Isaac H. Chappell, William Barclay Charles, Robert Chase, George M. Chintala, John Chiodo, Ray Cinelli, Don O. Clair, M. W. Clair, Jr., E. Donaldson Clapp, R. Henderson Clark, F. W. Clarke, Jr., N. Clausen, B. E. Clement, Clarence E. Coburn, Paul A. Coffey, Martin Coleman, Peter Colm, Louis J. Compton, W. R. Conlon, J. Carl Conner, Herbert T. Conover, Lewis C. Cook, Raymond E. Cook, W. P. Cooney, Theodore H. Cooper, J. L. Copeland, Franklin S. Coplan, Russell Cornette, Philip H. Cornick, Warren H. Corning, Herman Cowan, E. V. Cowdry, Jr., D. W. Cox, Thomas Crane, Randall Crawford, Emerson D. R. Creveling, Geo. L. Crosby, Halsey E. Crosby, Vaughn E. Crouthers, Thomas Ridley Currie, Walter W. Curry.

G. Harris Daggett, Leonard M. Daggett, Orta Lindon Darling, Kenneth H. Davenport, Lynch Davidson, William L. Davidson Courtland V. Davis, E. W. Davis, L. Glenn Davis, Alexander K. Dean, Ivan Decker, Charles A. Deile, Louis M. Dennison, Charles G. Deno, Benjamin E. DeRoy, Gerard J. Descheemaeker, Raymond J. Dhuy, Lyle A. Dickey, George A. Dietrich, Edwin W. Dilger, John Doane, J. Newton Dodd, Allen S. Dolgin, Eugene E. Doll, George H. Donaldson, Robert N. Donaldson, Thomas E. Dooley, Andrew E. Douglass, 2d., Curtis Douglass, Henry Dourif, Frederick M. Doyle, W. H. Drake, Ernest C. Driver, Frank Sylvester Drury, Ben Du Bois, Stuart R. Ducker, John H. Duffy, Frank Duncan, Joseph A. Duner, T. Evans Dunn, Jr., L. B. Dunnigan, Eugene Tasset du Pont, Herbert A. Durfee, Stanley Dyson.

Arthur Lincoln Eaton, S. Ford Eaton, William J. Eck, Paul D. Edwards, Fred M. Eisenhauer, Robert J. Egliht, S. E. Elder, W. H. Ellison, Edward Charles Ellsworth, Adam E. Elsing, Olaf Elton, Hans F. Emmerling, Ralph J. Engelbrecht, Leon H. Ensworth, Mark L. Entorf, Elmore H. Erben, Francis R. Evans, Frank W. Evans, Jr., Russell W. Evans, Thomas W. Evans, William Everdell, 3d., Edward A. Everett, Henry L. Eversman, Sharp Ezzell.

Edward J. Fagan, John B. Farish, J. Farmer, A. L. Farr, Alfred C. Farrant, George Farrar, E. A. Fawley, John J. Fay, Sr., Henry R. Fechtman, Robert Fein, Samuel M. Feuer, Stephen H. Fifield, E. Howard Figg, Henry Finckh, J. Wilmer Fisher, John H. Fitzgibbon, John B. S. Fitzpatrick, George H. Flinn, Jr., D. E. Fogg, John B. Fogg, Fenton K. Forrest, Eugene Joseph Foster, Lawrence J. Frankel, Willard E. Fraser, V. L. Frazee, Herbert G. French Henry C. Frey, Nathan Friedman, Cecil E. Friend, Jesse Fript, Henry E. Fuss.

Ernest L. Gage, Harold W. Gale, Howard E. Gale, John G. Gale, James Gallagher, Shuler Stratton Gamble, Anthony H. Gamm, S. J. Gardiner, D. Thorne Gardner, Earle G. Gardner, Jr., F. M. Gardner, Warren E. Garretson, Alfred Gaskill, Reuben Gavoor, George Gebben, E. Harold Geer, Edward F. Giberson, Edwin F. Gildea, J. Gordon Gilfillan, Paul M. Gill, Claude W. Gillespie, Alexander R. Gillis, Jr., Theodore P. Gilman, Sidney S. Gimpelson, Milton W. Glenn, Howard N. Glover, Julius C. Gluck, Richard Goat, William R. Goerke, D. M. Goetschius, Joseph L. Goffio, C. P. Goldberg, Calvin Good, Ernest Eugene Good, Edward G. Goodell, Samuel Gilbert Gorsline, Charles H. Gray, George W. Gray, William Gray, R. T. Green, W. D. Green, Bernard C. Greene, Edward F. R. Greene, Morrison B. Greenlaw, W. A. Griffith, F. C. Grimes, Ernest D. Griswold, Philip R. Gruger, A. L. Guentner, Edward P. Guerin, E. A. Gustavson, Leo Guzik.

Joseph F. Haas, G. F. Hadder, Fred K. Haggard, Albert C. Hall, James Gerard Hall, Walter E. Hallett, David Halpern, Bolivar Hamilton, F. P. Hamilton, Lee Hand, William H. Hand, John W. Hanes, Jr., Fletcher Hanks, Bernard Harkness, Chester E. Harpel, Thomas B. Harper, Franklin S. Harris, George L. Harrison, E. Clark Harter, C. H. W. Hasselriis, Arthur A. Hauck, George F. Hauser, Lowell E. Havens, Charles F. Hawk, Paul Hawkins, Howard A. Hayden, Raymond E. Hayford, Raymond B. Haynes, Mortimer Hays, Ira N. Hayward, F. J. Haywood, T. J. Heeg, Andrew H. Heermance, Albert O. Heilner, Wm. F. Hein, George W. Heintz, Nathan Heller, Weston Hellmuth, James R. Hendrickson, Clyde L. Henman, James Everell Henry, E. A. Herider, Lloyd Herrett, I. A. Herskowitz, Herbert N. Neston, Wallace E. Hiatt, S. J. Hieronymus, H. Wadsworth Hight, George H. Hiles, Charles Arthur Hill, Jr., Hedley Hill, Robert H. Hite, Albert Hoffard, J. C. Hoffman, Frank E. Hoffmann, Daniel A. Hogan, R. E. Hollingshead, David Garber Hollister, Ralph Holly, Ragnhild Slaalien Holm, Jesse H. Holmes, M. L. Holmes, H. R. Holstrom, George Holtsberg, Arthur Grant Hoover, Henry D. Hoover, Rupert H. Hopkins, Walter John Horn, Francis Horton, Jos. S. Horton, Jr., J. H. Hostetler, Robert J. Hotchkiss, Harry House, Frank C. Howe, Samuel B. Howe, W. M. G. Howse, Frank Murray Hoyt, Philip Spear Hoyt, John J. Huggins, Dan A. Hulick, George W. Humphreys, P. P. Hungerpiller, Dexter R. Hunneman, Jr., Malcolm Parkes Hunt, Harry H. Hunter, Frank L. Hupp, Jerome R. Hurd, John J. Hurley, Edw. J. Hurni, Chase Hutchinson, Hubert Elmer Hutchinson, Robert L. Hutchinson, Harold O. Hutt, Clarence J. Hylander, Thomas O. Hynes.

Chas. F. Ikle, A. M. Ingold.

John Early Jackson, Raymond I. Jacoby, Jacob Jacowitz, Robert Huddle Jamison, A. L. Jaqua, Arthur C. T. Jenkin, Herbert A. Jewett, Earl E. Joachim, C. E. Johnson, Harry L. Johnson, Karin Elin Johnson, Roscoe R. Johnson, Willis Johnson, Jr., A. E. Johnston, Thomas H. Johnston, Joseph W. Jones, K. L. Jones, N. G. Jones, Theodore L. Jones, H. R. Jordan, Robert Joseph, Henry B. Joy, Temple N. Joyce.

J. Arthur Kapteyn, Gilbert Russell Karnig, Harry Kasofsky, Irma S. Kast, Theodore Kaufman, Warren E. Kay, Harold Kaye, Stephen Keckeissen, Harry Keilin, Thomas J. Kelley, George W. Kelly, John Kennedy, Raymond E. Kenny, William B. Kent, David Keppel, C. C. Kerr, George B. Kimbler, William H. King, Philip W. Kingsley, H. Stetson KinKaid, E. F. KinKead, Philip Kinsley, John H. Kiplinger, Samuel B. Kirby, Jr., N. Glenn Kirk, Charles E. Kistler, Ralph Klipin, Gerald W. Knechtel, C. L. Knight, John Koopman, E. G. Kralovec, William Assen Krametz, J. D. Kuykendall.

C. M. Labunski, Amos L. Lachapelle, A. J. Lafleur, Jack K. Lail, A. E. Landerholm, Charles H. Landon, Charles E. Lane, Wann Langston, Jr., John A. Lappin, Edward C. Lapping, Daniel I. Larkin, Irvin C. Larsen, Abel Larson, L. H. Larson, Leon Laskaris, H. J. Lawson, D. B. Layne, Alwin M. Leber, Emerson Le Clercq, James L. Ledbetter, Sidney J. Lee, Tom W. Leedham, A. T. Leedy, Clarence T. Leinbach, O. Carol Lempfert, Sam Lerman, Stuyvesant LeRoy, Ray J. Lessard, William A. Leutz, Richard A. Levasseur, Murray E. Levine, William Levinson, Josef Lhevinne, J. E. Lieb, R. L. Liebenberg, G. E. Liesemer, James H. Lightbourne, Paul M. Limbert, Sandy Lindsay, Saul Litt, Edmund P. Livingston, J. A. Livingston, Paul Llewellyn, Walter M. Lloyd, Wallace Lomoe, Amos Prescott Loomis, Howard Loomis, Fred T. Lottman, W. D. Lovell, Mark Lowry, Edward J. Lucke, V. J. Lumley, Harry Lustgarten, Albert Howe Lybyer, C. Glenn Lyman, J. Henry E. Lyon, John D. Lyons.

John Stewart MacClary, John A. MacLean, Cargill MacMillan, O. T. Madsen, Edw. G. Magnuson, F. B. Maldonado, T. S. Malone, Reginald P. Manners, W. K. Mansfield, M. Lynn Marcotte, Charles H. Marcy, H. C. Markman, Louis D. Marriott, Eugene S. Marshall, Raymond Martin, Robert Hewitt Martin, T. W. Martin, Edward C. Marts, Harding T. Mason, Paul W. Masters, Vernon May, Malcolm R. McBride, E. L. McClain, Jr., Harry Watson McClellan, E. I. McClintock, E. O. McCormick, Horace D. McCowan, B. B. McCreight, Hubert L. McCullough, A. R. McDermott, Thomas F. McDermott, James B. McDonough, Thomas McGivern, John E. McGlashan, J. P. McGlasson, E. B. McGuinn, Allan J. McIntosh, William McKay, Henry J. McKenney, Leal C. H. McLean, B. H. McMahan, James C. McManaway, H. R. McNamara, K. G. McPhee, E. C. McQueeney, Allen A. McShea, Holland McSwain, Harry J. McTiernan, Norman C. Meier, Ernest J. Meili, Henry W. Meissner, C. T. Melvin, Fred Menke, Alexander Menzel, Lyman L. Merriam, Alfred S. Merrifield, Whitney Merrill, J. M. Merritt, Clarence Mershon, Charles R. Messeloff, Ervine Metzl, Henry C. E. Meyer, J. L. Meyers, Stewart H. Michales, Owen C. Middleton, C. B. Millard, Alter J. Miller, Earl W. Miller, Edgar G. Miller, Jr., George D. Miller, J. N. Miller, Merrill Miller, L. C. Mitcham, James P. Mitchell, Ralph B. Mitchell, Richer Mitchell, William H. Mitchell, Kai M. Mohr, A. W. Monosmith, John R. Montgomery, Frederick T. Moore, Fritz Moore, John Applegate Moore, Wesley C. Morck, W. E. Moreland, Elmer J. Morgan, J. Boyd Morris, Charles A. Morrison, Robert K. Morrison, Charles H. Morse, George F. Mueden, Glenn G. Munn, Alfred H. Murphy, Gerald E. Murphy, John W. Murphy, Lawrence W. Murphy, Thos. J. Murray, Benjamin W. Musser, William C. Mustard, Jr., Max I. Mydans, Edwin A. Myers, Sutton Myers.

J. G. Nasholds, Albert Nelson, Charles D. Nelson, George B. Nelson, John O. Nelson, Lloyd C. Nelson, Paul Nelson, Lawrence C. Newlands, C. B. Newton, A. R. Nichols, Samuel L. Nicholson, Soterios Nicholson, Clarence W. Nickerson, Wilbur M. Niesley, Carl B. Nissen, Frederick J. Noer, David J. Nordberg, Herndon J. Norris, Robert Northrop, M. H. Norton, Frank Huxley Nowaczek.

W. G. O'Barr, Harold J. O'Connell, Dan O'Leary, Eugene Edward Ormsten, John Overwater, Robert Owen, Choki Oyama.

Luther W. Packard, Charles R. Page, H. B. Paige, Irving A. Palmer, J. S. Palmer, John C. Palmer, Jr., John P. Palmer, Henry Clifton

Pannell, C. P. Pardue, Geo. S. Parker, Warren Parmelee, D. S. Parry, Floyd W. Parsons, Wm. Tait Paterson, Carlton J. Patton, J. D. Patton, Anthony J. Pawlak, Leon A. Payne, J. Pearson, Albert E. Pecore, Burton F. Peek, Robert D. Pepper, Charles L. Peters, William H. Peters, Edouard A. Petrequin, Bernard C. Phillips, L. R. Phillips, Harry B. Pickering, Philip J. Pinkus, Lewis P. Pitt, R. G. Plews, Frank J. Pokorny, David Porter, Joseph F. Porter, Robert Porter, E. L. Powel, George F. Powell, James William Powles, Conrad Clark Pressey, Wilmer Pringle, Edwin W. Proctor, Lynn Irving Pruitt, Thomas Milton Putnam, Jr.

Wickham Quinan.

J. D. Ramsay, Fred A. Rantz, G. E. Rarig, George A. Raymer, Robert V. Redpath, Jr., David M. Reed, Benjamin Rees, Orson H. Reeve, Irving W. Reeves, Richard E. Regan, Bruno C. Reich, Jr., Victor Reichert, Frank D. Rentchler, Clarence N. Reynolds, Edgar T. Reynolds, Everett A. Reynolds, Leland W. Rhees. Ricardo Vidal Ribas, Willis H. Rich, John J. Richards, Lawrence Richards, Yale T. Richardson, George P. Richter, Arthur F. Riegel, G. Fred Rieman, Frank Rimeck, Ceaser Rinaldi, Thomas Dunning Rishworth, John H. Ritchie, Hans Ritter, Alfred E. Roberts, Everett G. Rodebaugh, Edwin Roedel, J. Dewey Roggen, Wilfred A. Rohde, Morris Rohrberg, E. P. Roleson, Roy Curt Rom, John Aspinwall Roosevelt, Alfred F. Rose, Bernd Phelps Rose, C. G. A. Rosen, Jack Rosenbloom, William Rosengren, Robert Rosenzweig, D. Walter Ross, Arthur V. Roth, Mossman Roueche, Joseph D. Ruddley, Frederick J. Rupp, William M. Rush, Wirt Russ, Walter Russell, H. R. Rutledge, Frank B. Ruwwe, F. M. Ryburn, Donald Bohn Rymer.

Benjamin Sachs, James B. Sager, Peter D. Salini, Jr., Henry F. Salkeld, Seymour Saltus, DeWitt Sanders, Jr., E. J. Sawyer, P. M. Saxman, Jr., Grover C. Sayre, Frank R. Schetty, Stephen Schillig, Charles I. Schmitt, O. Paul Schubert, Alfred T. Schultz, Charles Scott, E. C. Scott, Malcolm M. Scott, Percy Dayton Scoville, Thomas S. Screven, Andrew M. Sea, Jr., Hans W. E. Seltmann, Richard W. Selwood, John J. Senesi, Robert M. Senior, L. R. Severinghaus, James M. Shackleton, J. H. Shannon, Norvelle W. Sharpe, 3d., Graham C. Shaw, Isidor Shaw, Lawrence A. Shaw, Claude A. Sheffner, D. C. Shepherd, T. A. Sherard, R. E. Shimmin, Charles Shiverick, J. L. Shonkwiler, R. M. Shontz, Edward S. Shorter, Walter Siegel, Edward J. Sieler, Jr., Joseph Neil Sifford, John C. Silsby, Charles R. Simmons, Ralph L. Sisson, Charles K. Skinner, George De Nevin Skinner, R. N. Skinner, J. Noah H. Slee, John Milton Slim, Jr., William H. Smails, James C. Smillie, Charles S. C. Smith, George Albert Smith, Marshall E. Smith, Ralph H. Smith, Solon W. Smith, W. A. Smith, W. Corell Smith, Wm. L. Smith, Hampton K. Snell, John E. Snodgrass, William C. Snow, David Soifer, Herbert Somers, Hans Sorensen, Carleton S. Spear, George A. Spelts, C. Spencer, Chas. W. Spencer, R. Chester Spencer, Sidney Spieler, J. H. Spight, Jr., Ernest Stout Spittler, Harry Spitz, George C. Sponsler, Jr., John Sprowl, J. David Spruill, T. A. Stafford, Leon C. Staples, Carl A. Starck, Thomas O. Starr, Edward W. Stearns, Peter Steckler, Charles Stein, Harry Stein, Herman W. Steinkraus, Carl Stemmler-Morath, Arthur Stephan, Frank R. Sterba, Jr., Aron Steuer, W. Elliott Stevens, Asher G. Stewart, James L. Stewart, Samuel L. Stewart, George J. Stratton, Aubrey H. Straus, Walton L. Strauss, George A. Strong, J. Edmund Struthers, Hugh James Stryker, Frederick G. Stuart, O. H. Stuteville, Thomas R. Supe, John W. Suter, 3d., Melvin L. Sutley, Truman Swallow, Tom C. Sweeney, B. F. Swing.

Vincent Tartaglia, Ellison H. Taylor, Graham R. Taylor, John C. Taylor, Paul L. Taylor, T. D. Taylor, William S. Taylor, C. H. Temple, Tom Thaggaro, Charles E. Theobald, Robertson Thomas, H. J. Thompson, Harold C. Thompson, Roy Thompson, T. Leigh Thompson, Th. I. Thomsen, Edward D. Thomson, H. Britton Thomson, Jack E. Thomson, Jr., Warren F. Thummel, Charles T. W. Tigh, C. H. Tinsley, Charles Potter Titsworth, Rudolph Lincoln Titus, Franklin J. Tobey, Jr., Lionel L. Tobias, Michael I. Tomilin, W. B. Tongue, Jr., Geo. P. Topping, Clarence W. Torset, William J. Tracey, Daniel O'Connell Tracy, G. H. Trainer, Richard H. Trent, Howard M. Trueblood, Howard James Turnbull.

Edward Lewis Uhlman, T. B. Upchurch.

Clyde Van Gorder, Jan A. van Laer, Jr., Edgar B. VanOsder, J. F. VanVoorhis, Thomas L. Vase, L. Vaughan, Jr., W. Gerard Vermilye, Alan W. Vint, Louis Visalli, Robert Vogelbach, William Vogt.

Samuel R. Wachtell, C. C. Wade, Stewart C. Wagoner, Chas. J. Waldmann, Jack Walker, William H. Walker, Hugh Wallace, D. J. Walter, Joseph A. Ward, Austin D. Warnken, John B. Warnock, George C. Warren, E. B. Waterhouse, T. M. Watlington, Buron A. Watson, Warren F. Wattles, Harold G. Watts, Walter G. Way, H. O. Weaver, Raymond Weaver, Frank L. Webber, C. F. Weber, William J. Weber, August W. Weigl, Alvin Weimer, E. Frank Weisman, Howard M. Wells, P. G. Wells, Ralph W. Wells, Abraham P. Wernik, Adolf Werum, C. Arthur West, Frank M. Wheat, F. E. Wheaton, Francis D. Wheeler, Edwin E. Whipple, Henry W. Whipple, Alfred J. White, Edmund A. White, J. Sloane White, Lytle White, W. W. White, A. Pennington Whitehead, Jesse Widby, Theodore Wiedeman, H. C. Wiggers, Frederick Carl Wiggins, H. C. Wiggle, Harley F. Wight, John Wikman, Harold C. Wilcox, S. Wirt Wiley, Charles L. Wilhelm, DeWitt R. Williams, J. Paul Williams, W. Clifford Williams, Robert Dickson Williams, Frank Robert Wilson, H. L. Wilson, W. B. Wilson, Walter E. Wilson, Francis H. Wing, Harlan Winn, Edward Winterer, Harry Witt, Daniel Wolf, Roland A. Wood, Harding C. Woodall, Frank H. Woodbury, Jr., George L. Word, Jr., E. C. Worman, N. Walker Wright, Charles N. Wysong.

Edmund W. Yard, Merrill C. Yost.

Jacob W. Zang, Elwood W. Zoeckler, Howard H. Zwicker.

Members of the American Museum and subscribers to Natural History *are reminded that no numbers will be published during July and August. The first issue to appear after June 1 will be the September number.*

An index of the contents of Natural History *for the first six months of 1935 is in course of preparation. Copies may be obtained by application to The Librarian, American Museum of Natural History, 77th Street and Columbus Avenue, New York, N. Y.*

BOOKS BY MUSEUM AUTHORS

for sale by THE AMERICAN MUSEUM OF NATURAL HISTORY

Boy Scout Book of True Adventure	$2.50
The Earth, the Seas and the Heavens. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00
Fishes, Insects and Reptiles. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00
Mammals and Birds. A Selection of Articles from the New 14th Edition of the Encyclopaedia Britannica	3.00
AKELEY, CARL AND MARY JOBE	
Adventures in the African Jungle	3.00
Lions, Gorillas and Their Neighbors	2.50
AKELEY, MARY JOBE	
Carl Akeley's Africa	5.00
ANDREWS, ROY CHAPMAN	
Across Mongolian Plains	5.00
Ends of the Earth (1st edition 1929)	4.50
Ends of the Earth. (Star edition)	1.00
New Conquest of Central Asia. Vol. I. Natural History of Central Asia	10.00
On the Trail of Ancient Man	6.00
Whale Hunting with Gun and Camera	5.00
ANDREWS, ROY CHAPMAN AND YVETTE BORUP	
Camps and Trails in China	5.00
ANTHONY, H. E.	
Field Book of North American Mammals	5.00
BARTLETT, "BOB"	
Sails Over Ice	3.00
BEEBE, WILLIAM	
The Arcturus Adventure	7.50
Beneath Tropic Seas	3.50
Galapagos, World's End	6.00
Jungle Days	3.00
Pheasant Jungles	3.00
BEEBE, WILLIAM AND TEE-VAN, JOHN	
Field Book of the Shore Fishes of Bermuda	3.50
BERKEY, CHARLES P. AND MORRIS, FREDERICK K.	
Geology of Mongolia. Vol. II. Natural History of Central Asia	10.00
BRAND, A. R.	
Songs of Wild Birds. (Has two phonograph records, songs of 35 birds)	2.00
BREDER, C. M., JR.	
Field Book of Marine Fishes of the Atlantic Coast	5.00
CARNOCHAN, F. G. AND ADAMSON, H. C.	
The Empire of the Snakes	2.50
CARR, WILLIAM H.	
Glimpses of Familiar Birds	1.00
The Stir of Nature	2.50
CHAPMAN, FRANK M.	
Autobiography of a Bird-Lover	3.75
Bird-Life	4.00
Bird Studies with a Camera	3.00
Camps and Cruises of an Ornithologist	4.00
Color Key to North American Birds	4.00
Handbook of Birds of Eastern North America. 2nd Revised Edition. 1932	5.00
My Tropical Air Castle	5.00
Our Winter Birds	2.00
The Travels of Birds	.76
What Bird is That?	1.50
CLARK, JAMES L.	
Trails of the Hunted (First Edition)	$4.00
COATES, C. W.	
Tropical Fishes for a Private Aquarium. (Tropical Fishes as Pets)	2.00
CURRAN, C. H.	
The Families and Genera of North American Diptera	7.50
DITMARS, RAYMOND L. AND CARTER, HELENE	
The Book of Zoography	2.00
FISHER, CLYDE AND LANGHAM, MARION	
Nature Science	
Book I. World of Nature	1.20
Book II. Ways of the Wild Folk	1.20
Book III. Our Wonder World	1.20
Book IV. In Field and Garden	1.20
GLEASON, H. A.	
Plants of the Vicinity of New York	1.65
GRABAU, AMADEUS W.	
The Permian of Mongolia. Vol. IV. Natural History of Central Asia	10.00
GRANT, MADISON	
Passing of the Great Race	3.50
GREEN, FITZHUGH	
Roy Andrews—Dragon Hunter (A book for boys about Dinosaurs and Bandits)	1.75
GREGORY, WILLIAM KING	
Man's Place Among the Anthropoids	2.50
Our Face from Fish to Man	5.00
HARING, H. A.	
The Slabsides Book of John Burroughs	2.50
JOHNSON, MARTIN	
Cannibal-Land	1.00
Lion	5.00
Safari	5.00
JOHNSON, OSA HELEN	
Jungle Babies	1.75
KNIGHT, CHARLES R.	
Before the Dawn of History	2.50
KUNZ, GEORGE F.	
The Magic of Jewels and Charms	8.50
Rings for the Finger	8.50
LAMONTE, FRANCESCA AND WELCH, MICAELA	
Vanishing Wilderness	2.50
LEDERER, N.	
Tropical Fish and their Care	2.50
LEIGH, W. R.	
The Western Pony	10.00
LORIMER, FRANK AND OSBORN, FREDERICK	
Dynamics of Population	4.00
LUTZ, FRANK E.	
Field Book of Insects	3.50
MCCREERY, JAMES LINDSAY	
Exploring the Earth and Its Life	2.00
MCSPADDEN, J. WALKER	
To the Ends of the World and Back. Scouting for a great Museum (The American Museum of Natural History)	3.00
MANN, PAUL B., AND HASTINGS, GEO. T.	
Out of Doors. A Guide to Nature	2.00
MASON, GREGORY	
Columbus Came Late	4.00
MEAD, MARGARET	
The Changing Culture of an Indian Tribe	$4.50
Coming of Age in Samoa	3.00
Growing Up in New Guinea	3.50
Sex and Temperament in Three Primitive Societies	3.00
MEDSGER, OLIVER P.	
Nature Rambles *Spring*	2.00
" " *Summer*	2.00
" " *Autumn*	2.00
" " *Winter*	2.00
MORDEN, WILLIAM J.	
Across Asia's Snows and Deserts	5.00
MURPHY, ROBERT CUSHMAN	
Bird Islands of Peru	6.00
NICHOLS, J. T. AND BREDER, C. M., JR.	
The Marine Fishes of New York and Southern New England	1.40
NOBLE, G. KINGSLEY	
The Biology of the Amphibia	5.00
OSBORN, HENRY FAIRFIELD	
Cope: Master Naturalist	5.00
Creative Education in School, College, University and Museum	2.50
The Earth Speaks to Bryan	1.00
Evolution of Mammalian Molar Teeth	2.75
Evolution and Religion in Education	2.00
Fifty-Two Years of Research, Observation and Publication, 1877–1929	1.50
From the Greeks to Darwin	2.50
Impressions of Great Naturalists	2.50
Man Rises to Parnassus. 2nd Edition	3.00
Men of the Old Stone Age. 3rd Edition	5.00
The Origin and Evolution of Life	4.00
POPE, CLIFFORD H.	
The Reptiles of China. Vol. X. Natural History of Central Asia	10.00
REEDS, CHESTER A.	
The Earth. Our Ever-Changing Planet	1.25
SCHWESINGER, GLADYS C.	
Heredity and Environment	4.00
SIMPSON, GEORGE GAYLORD	
American Mesozoic Mammalia	5.00
Attending Marvels. A Patagonian Journal	3.00
STEFANSSON, V.	
The Friendly Arctic	6.50
My Life with the Eskimos—New and Abridged Edition	2.50
VANDERBILT, WILLIAM K.	
Across the Atlantic with *Ara*. Summer 1924	5.00
15,000 Miles Cruise with *Ara*. 1927	5.00
Taking One's Own Ship Around the World	30.00
To Galapagos on the *Ara*	30.00
West Made East with the Loss of a Day	20.00
WALKER, EDITH B. AND MOOK, CHAS. C.	
Tales of the First Animals	1.50
WISSLER, CLARK	
The American Indian	5.00
Introduction to Social Anthropology	3.50
Man and Culture	2.75
Relation of Nature to Man in Aboriginal America	3.50

Address orders to The Librarian

THE AMERICAN MUSEUM OF NATURAL HISTORY
77th STREET AND CENTRAL PARK WEST :: :: :: NEW YORK, N. Y.

Remittances must accompany all orders—Include 10 cents per volume for postage

Museum Animal Theatres

ANIMAL THEATRES reproduced from the lifelike exhibits in the Museum — four of these fascinating theatres to be set up which will prove a delight to every boy and girl possessing them. It will be an absorbing work to cut out and arrange these theatres — hours of anticipation. What a supreme delight would these have been to the young people in Little Women! The animals may be moved about and no paste is necessary. It is a natural history exhibit that can be staged in any home. The backgrounds are taken from the exhibits in the Museum and the animals modeled on those seen in the groups.

No. 1 represents the African Lion *(Felis leo)*. It is a scene on the edge of the mysterious veldt near Nairobi, British East Africa. The king of beasts is waiting, with his family, under a tree for the dusk to descend prior to their sally for the evening meal.

No. 2 represents the Bengal Tiger *(Felis tigris)* in the Kheri forest in India. The tigress leads her cubs to the stream to drink and through the reeds and trees appears the lordly male. This represents one of the groups collected for the American Museum by the Vernay-Faunthorpe Expedition.

No. 3 is the Gorilla *(Gorilla savagei)*. Here we see the Lake Kivu region of the Belgian Congo with the slope of Mt. Mikena showing in the purple sunset. This great animal was carefully studied by Carl E. Akeley on his many trips to Africa and from this theatre one will glean many interesting facts about a creature that has long been too little known.

No. 4 is the African Elephant *(Elephas africanus)*. The world's largest game animal is seen in a beautiful setting near Lake Paradise, British East Africa. The group is dispersing to cover after having been startled and the great bull wheels about to charge the enemy.

Each theatre when set up measures 18″ wide, 10″ high and 8″ deep. Maps and descriptive material accompany each set. Because of their artistic colors, these animal groups make unusual decorations in the home as well as being splendidly adapted for class room use and above all for the playroom of every child. Price, $1 per set, parcel post charges additional. The weight packed for transportation is 3 lbs.

Address all orders to

THE REGISTRAR, THE AMERICAN MUSEUM OF NATURAL HISTORY
77th Street and Central Park West, New York City

RUMFORD PRESS
CONCORD, N. H.

LET'S DO THIS THING SYSTEMATICALLY!

It pays to get all the facts. Sharpen your pencil and check off your vacation "musts" — they're all combined in these cruises.

★ **THE SHIPS**
New ships built especially for West Indies service with exclusive air-conditioned dining rooms. All rooms outside and amidships with Punkah Louvre Ventilation even at minimum.

★ **ITINERARIES**
Circle the entire Caribbean including South America in 18 days or visit Haiti, or Haiti and Jamaica in 11 days. Direct docking at regular ports. No disagreeable tender transfer.

★ **CRUISE FACILITIES**
Smart outdoor, verandah swimming pools! Broad, outdoor sports decks! Motion pictures. Dancing, Orchestras, Celebrated cuisine. Plus the personal note.

★ **HIGH-SPOTS ASHORE**
See colorful native life in Port-au-Prince. Picturesque British Colonial Kingston. In Colombia visit celebrated San Felipe fortress, Spanish cathedrals, etc. See the world famous Panama Canal.

★ **RATES AND SAILINGS**
11 Day all-Expense HAITI cruise. Allowing 3½ days and 3 nights in Haiti. Room and meals at first class hotel in Port-au-Prince. Motor sightseeing. $115 up

Voila!
"it's all settled"

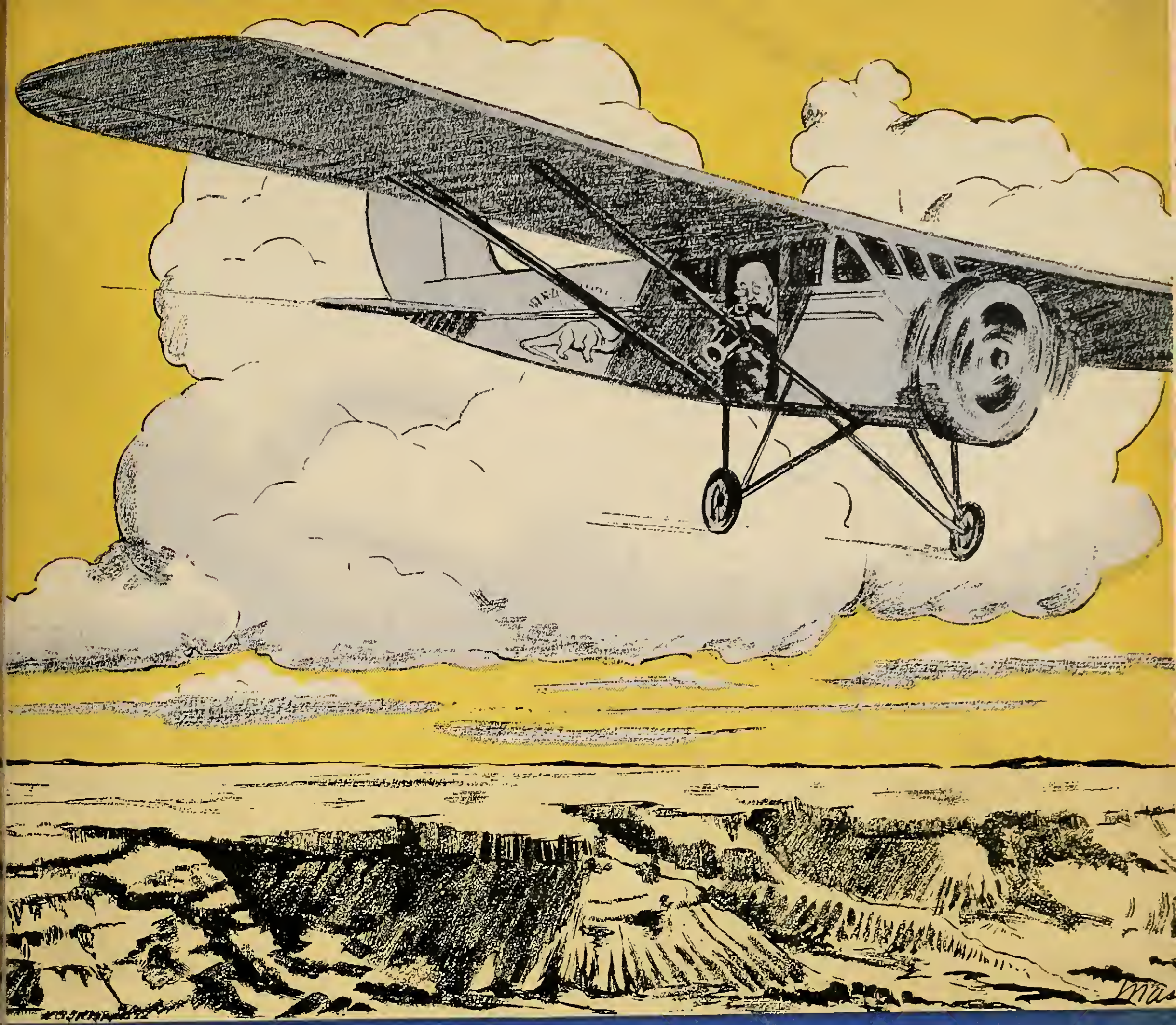
11 Day all-Expense HAITI-JAMAICA Cruise. 1½ days and night in Jamaica, 2 shore visits in Haiti. Motor sightseeing in each country. $130 up.

18 Day COMPLETE Cruise. Haiti (Port-au-Prince, 2 leisurely visits); Jamaica, 2½ days and one night. Probably a visit to a Jamaica outport; Colombia, So. Am. (1 day and evening in Puerto Colombia and Barranquilla. 1 day in Cartagena); Panama (2 whole days and one night).

A Sailing Every Thursday from New York

Colombian Line, 17 Battery Place, New York City

COLOMBIAN CRUISES
Line **TO THE SPANISH MAIN**



NATURAL HISTORY

OURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

FIFTY CENTS SEPTEMBER 1935

Coming Soon — A New Book by

ROY CHAPMAN ANDREWS

Eminent Scientist and Explorer, Director of the American Museum of Natural History

THIS BUSINESS OF EXPLORING

To be published October 15th. Place your order now for a copy of the first edition

Dr. Andrews now tells, for the first time in book form, the complete story of the Gobi Expeditions in 1928 and 1930; where he went; what he did; and how he found the tomb of the great shovel-tusked mastodons. The considerable accomplishments of these latest expeditions are fully recounted along with many amusing and delightful sidelights on an explorer's life. Out of his rich experiences, Dr. Andrews, in addition, surveys the whole field of exploration, and devotes a considerable portion of the book to answering questions in every one's mind on the why and how of becoming an explorer, what training one must have, the organizing of an expedition, the problems and methods of exploring, and the wide and fascinating field that still exists for explorers of the future. Profusely illustrated. $3.00

Something New in Biography

SINGING IN THE WILDERNESS

By Donald Culross Peattie

One of America's great poet-naturalists brings to life the heroic idyll of John and Lucy Audubon. A story that is a unique and important part of our natural heritage. Illustrated. $2.50

DONALD CULROSS PEATTIE—

was acclaimed one of America's most gifted singers of Nature and her beauties when his book, "An Almanac For Moderns," was published last spring.

"What he writes is literature and his purpose is to share the delight which nature gives him. He knows much which Thoreau never suspected."
—*Joseph Wood Krutch in the Nation.*

"His prose is pure poetry. He writes unadulterated music." —*Sterling North in Chicago Daily News.*

"Superb . . . takes its place with the work of Thoreau, Hudson, Cunningham-Grahame."
—*Burton Rascoe in Esquire.*

G. P. PUTNAM'S SONS, 2 WEST 45th STREET, NEW YORK

NATURAL HISTORY

The Journal of the American Museum of Natural History

VOLUME XXXVI ★ ★ ★ ★ SEPTEMBER 1935

Aërial Photography in the Southwest .... *Cover*
From a drawing by George F. Mason

In the Valley of the Big Horn .... *Frontispiece*

Flying for Dinosaurs .... Barnum Brown 95
A 20,000-mile Panorama. The Most Ambitious Aërial Fossil Hunt Ever Attempted

Living Honey Jars .... A. C. Cole, Jr. 117
How the Thrifty Ant Stores Food and Solves the Problem of Survival in Its Social Organization

Fishes in Armor .... Myron Gordon 124
Protected from Sea-marauders by a Coat of Sharp Spines, the Porcupine Fish Swims About in Comparative Safety

A Whale Shark in the American Museum .... E. W. Gudger 128
The Skin of a Fifteen-foot Specimen from Acapulco, Mexico. The World's Seventy-Seventh Record

To the Strange "Buttons" .... Alfred O. Gross 133
The Story of the Bowdoin-MacMillan Arctic Expedition of 1934

Konrad Gesner Was Right .... Willy Ley 149
A Profile of the "Father of Modern Zoölogy"

Buffalo Hunt—1935 .... George G. Goodwin 156
Airplane, Pack Horse, and Dog Sledge Carry a Modern Expedition to the Last Refuge of the Wood Buffalo

Salamanders .... Charles E. Mohr 165
Modern Representatives of the First Back-boned Animals to Live on Land

Science in the Field and in the Laboratory 174
Current Events in the World of Natural History

Reviews of New Books 177
Recent Publications for Those Interested in Nature

EDITORIAL: Edward M. Weyer, Jr., Editor; A. Katherine Berger, Associate Editor; Dorothy L. Edwards.

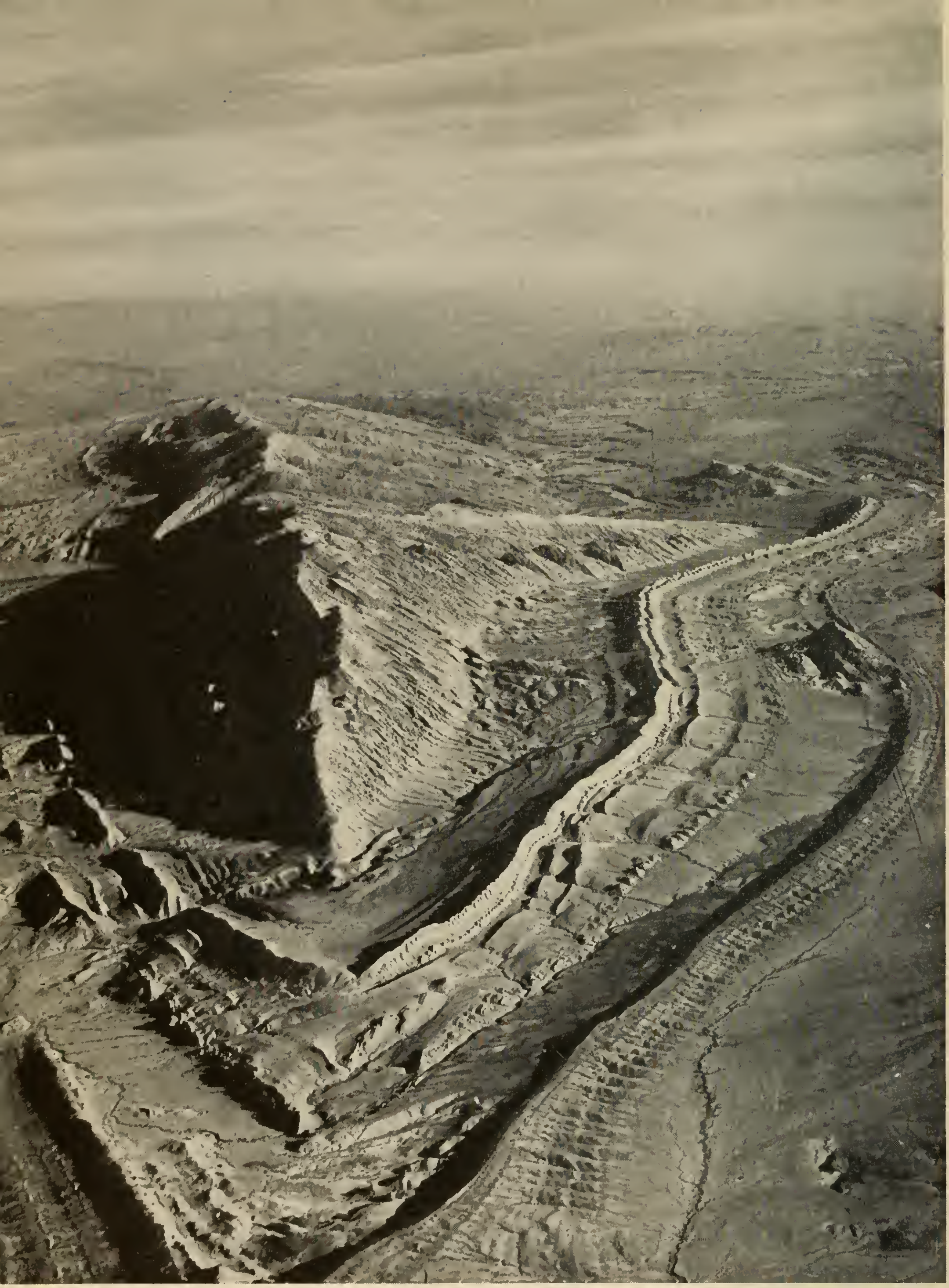
Manuscripts should be sent to the Editor, The American Museum of Natural History, New York, N. Y.

SUBSCRIPTIONS: NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership.

ADVERTISING: Tom Davin, Manager of Publications, The American Museum of Natural History.

PUBLICATION OFFICE: 246 Meadow Street, New Haven, Conn.

COPYRIGHT, 1935, by The American Museum of Natural History, New York, N. Y.



In the Valley of the Big Horn

Sheep Mountain, near Greybull, Wyoming. Like a jewel on the bosom of Mother Earth this elongate lavaliere-shaped mountain of white limestone rises evenly from a crinkly sculptured base of shales and sandstones, colored red, white, blue, maroon, red, gray—the most beautiful panorama of the aërial journey

Flying for Dinosaurs

A 20,000-mile panorama. The most ambitious aërial fossil hunt ever attempted unveils new vistas of life and conditions on the American continent below the horizon of time

By BARNUM BROWN
Curator of Fossil Reptiles, American Museum

[*The illustrations in this article, copyrighted by Barnum Brown, are a few of the spectacular shots taken with Fairchild aërial cameras during Dr. Brown's aërial survey, in the course of which he and his parties took more than nine hundred photographs.*

Many especially promising fossil areas were discovered in Triassic, Jurassic and Cretaceous strata previously thought to be completely explored, and such areas were immediately checked by a ground survey. Complete exploration of these regions will require at least three seasons of work by field parties.

Other important discoveries made during this reconnaissance are a quarry of large dinosaur bones in a Cretaceous formation in which bones had not been previously reported; a fine ceratopsian skull and jaws; a mosasaur skeleton; an unreported meteoric crater; an unreported ceremonial way of Tenth Century age, and several new oil domes and structures not yet drilled.]

ALL good ships have appropriate names. Our ship was christened "Diplodocus" with a picture of the beast painted on the side for our talisman—also as a lure for dinosaurs under the ground.

During the last four years the writer has had frequent opportunities to test the value of airplanes in geological work. On trips between Billings, Montana, and Denver, Colorado, when no other passengers were present, pilots would often deviate from the scheduled course, giving me an opportunity to study the Mesozoic strata where we were then working on the north flank of the Big Horn Mountains. With an intimate knowledge of the ground, I was thus able to establish the value of airplanes in fossil work.

Primarily, for an airplane to be most useful, one must have a previous knowledge of the characteristic features of the different formations to be examined. In most cases, with such information one can determine to complete satisfaction the continuance of strata, even where not exposed, or establish their lack of continuity. Rarely can one see individual fossils from the air, except occasionally with a field glass, but the features of structural geology as a whole are brought out in a way that can never be comprehended from a ground survey alone. The airplane opens up a new world to the geologist.

I had often discussed the possibilities of airplane work among associates and, when the matter was broached to officers of the Sinclair Refining Company, the proposal fell on receptive ears. In addition to funds for excavation work, this Company generously offered to supply me with an airplane for the time necessary to make required observations during the summer of 1934. I estimated we would cover about 8000 miles in the proposed aërial survey, and from previous experience calculated that the time beginning September 1 would best coördinate with excavation work at the Howe Dinosaur Quarry, so that I could carry on this investigation. Our flying base was Billings, Montana, headquarters for dinosaur field work during the past few years.

Before we left New York City, arrangements were made with the Fairchild Aërial Camera Corporation to ship us a 10-inch aërial camera, (I had negotiated unsuccessfully to secure the use of the Harvard University aërial cameras for our work), and much to my agreeable surprise, Weld Arnold appeared at our quarry the latter part of August with the complete Harvard aërial equipment, including the Fairchild 24-inch camera. This necessitated a rearrangement of the personnel but, fortunately, as circumstances developed, it gave us much greater latitude and enabled me to secure much finer photographic results than could have been obtained with the small camera alone.

I did not know who my pilot was to be, but the Sinclair people assured me he would be one of the best, and later I endorsed their judgment. Mr. D. A. McIntyre, of Tulsa, Oklahoma, was the pilot selected, and promptly on September 1 he arrived at Billings in his Lycoming powered Stinson. Knowing we would cover much mountainous country, I had stressed the necessity of having parachutes, and it was with considerable misgiving I learned from the pilot that no parachutes had been provided. He assured me that he did not feel the necessity of having them, but if required, they would be supplied later. After flying with Mac a few days, watching him maneuver his ship, I soon forgot about parachutes, and I firmly believe he could land his ship safely on any moderately flat ground lacking major obstructions.

Smoke palls retard photography

Our choice of September 1 proved to be unfortunate, as forest fires in Idaho and western Montana brought a pall of smoke over the entire region, making it practically impossible to take any reliable air shots in the Montana, Wyoming, and South Dakota areas where I wanted particularly to work. The smoke screen did not extend through the southern part of the Rocky Mountain region, and I decided to explore the Mesozoic rocks in southern Wyoming, Arizona, and New Mexico, and settle several doubtful geological problems in the South; then continue our northern exploration at the end of the season. This proved to be good judgment.

With all photographic equipment our load was more than two hundred pounds over weight for safe flying at high elevations, and it was a problem what to sacrifice. Finally, after several trial trips over near-by mountains, all surplus film was left to be shipped when required.

In order to use the big 24-inch camera, one door of the ship was removed and the camera suspended by heavy straps from the frame of the ship. In this way the camera could be extended while shooting and withdrawn into the ship while traveling. After many trial exposures we found that the smoke pall had settled down to such intensity that it was practically impossible to get perfect results with any type of filter.

Crossing the Pryor Mountains, our early flights were made over the Howe Dinosaur Quarry, twenty-five miles northeast of Greybull, Wyoming, and the region of the Big Horn Basin. I never cease to wonder at the marvelous panorama of Sheep Mountain, with its indescribably beautiful series of colored strata on the flanks, and its diagrammatic sculpturing. It offers an exceptional opportunity to reconstruct the original folding that has been erased by erosion.

After photographing the quarry thoroughly, all of our party of excavators were given short trips in the air from the field at Greybull. The Big Horn Basin was too full of smoke for us to do more than casually examine the classic Wasatch Tertiary beds east of Cody.

An interesting feature of air work soon became apparent—that high peaks and impressive scenery as viewed from the ground, fade out into inconspicuous elevations when seen from high up in the air, while flat country of upturned strata assumes great magnitude.

Leaving the Big Horn region, we headed southward, flying over the low-lying southern rim of the Basin above Wind River Cañon. Familiar scenes spread out below us with the well known fossil fields and productive oil structures in the vicinity of Lander. The smoke screen still made photographic work unsatisfactory. Here we found new fields for future ground work and continued our flight to Rock Springs.

Maps of the various States showing regular and emergency landing fields had been secured, and with Mac's perfect control of the ship, and my knowledge of the ground over which we were flying, ordinary automobile maps were used in charting our course. We knew our exact location during the entire flight, with one exception which I shall mention later.

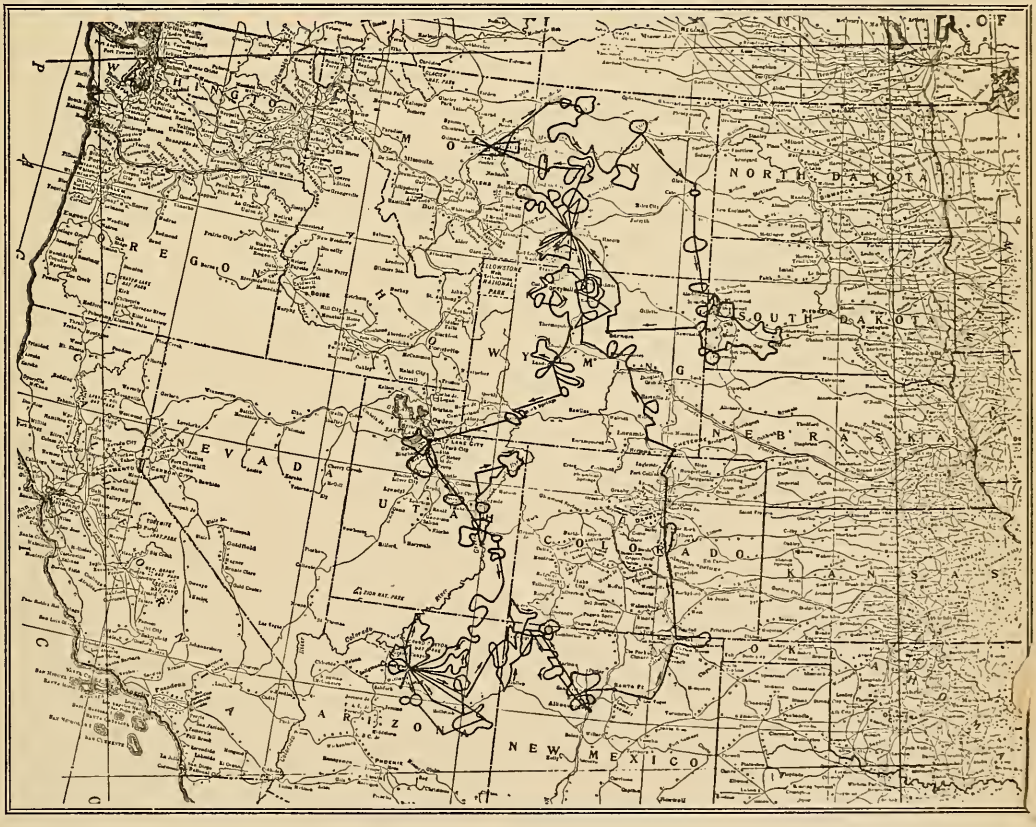
Our usual height, unless in high mountainous country, or where storms interfered, was from 3000 to 5000 feet, an elevation at which I could make regional observations of the geology much better than on the surface. In these six weeks in the air we secured data that could not be duplicated in twenty years of ground work.

The Rock Springs area is one of great importance in historical geology, for here in the coal mines are found the largest tracks of dinosaurs so far discovered. Many of them found in the roofs of mines are gigantic in size; larger than could have been made by any dinosaur known from skeletons, but so far, no bones have been recorded from these middle Cretaceous strata. Where there is smoke, however, there is usually fire, and here some day will be found the largest dinosaurs that ever existed.

Newspaper accounts heralded our course. I found friends expecting us at every port, and we were able to investigate the reported discovery of fossil bones wherever landings were made. Frequently when grounded, while Mac overhauled the ship, I secured automobile or horses and prospected limited areas, sometimes covering two or three hundred miles—traveling well into the night before returning for the next day's flight.

At airports along the regular routes of travel we obtained exact information of weather conditions, but as a rule depended on Mac's maneuvering ability when we encountered storms. By this time we had shaken down to regular routine work, determining the vagaries of "Diplodocus" under all conditions.

Rock Springs, Wyoming, has a fine field, but air currents swoop down over the surrounding hills, making it a ticklish port for those not accustomed to its peculiarities. We



Route of Flight

The American Museum-Sinclair Expedition in its aërial survey covered seven states and 20,000 miles from September 1 to October 15, 1934 followed the general course from Rock Springs to Salt Lake City at an elevation of 11,000 feet over the high Wasatch Mountains. Finding, however, that the Stinson labored hard with its heavy load over the regular route, we deviated considerably from the course in crossing.

Near Salt Lake City I wanted to obtain better records of the shore lines of ancient Lake Bonneville. By this time the air was sufficiently clear to enable us to make perfect pictures showing the different stages of recession of the great Pleistocene lake, which at one time covered a large part of Utah—the remnants of which are Salt Lake and fresh-water Utah Lake.

From Salt Lake City my intention was to cut eastward over the Wasatch and Uinta Mountains to the Dinosaur National Monument on the eastern border of Utah. The pass over the Wasatch Mountains, although at a high elevation, ordinarily offers no particular difficulties, but with our heavy load we circled many times in order to get elevation to clear the peaks. We finally decided that it was best to detour, following the general course of the railroad southward for some distance before taking an eastward course. We were busy, each with his own affairs—I following the map, Mac making his calculations, but in making the many circles we followed the wrong railroad. I could not understand why we did not pick up certain known points until suddenly off on the southern horizon I recognized San Rafael Reef. We were one hundred miles off our course.

An emergency landing

Gas was getting low when we realized our position and the nearest emergency field was Green River, Utah, forty miles away. Friends were there, we must land for gas, and there was no particular inconvenience, for this was one of the points selected for photographic work and geological study. We circled Green River a half dozen times, but there was no wind sock to be seen nor any sign of a landing field.

Finally I told Mac there was a fairly level stretch of sage brush four miles east of town where I thought we could negotiate a landing. Down we came on it, making a perfect three point contact—bumpy, of course, as sage brush would be, but everything went fine for two hundred yards when suddenly the left wheel struck a gophered sage brush. With the increased weight shifting to that side, the wheel sank, breaking several spokes. Hobbling along on the broken wheel for a hundred yards, like a maimed jack-rabbit, we finally came to a stop. We looked at each other without printable comment, for it was all in a day's work.

Friends at Green River saw us come down and came out to pick us up. With everything out of the ship, after a day spent in making repairs, we finally reached town where a good emergency field was found near the schoolhouse. Evidently school children had destroyed the markers—if they ever had been placed. Where airplanes are rare and people not used to flying, few realize what a godsend to airmen in difficulties are the cross strips of a level field and a tattered wind sock.

A hairbreadth escape

On our course to the Dinosaur National Monument, a good field was marked at Price, Utah, and we approached it with assurance, but to our surprise and consternation the runways were covered with mule teams leveling the field. In spite of our circling and signaling, every man stopped in his tracks to watch our maneuverings. We had to have gas in order to reach Vernal, and land we must! One runway was covered with Russian thistles, but looked as though it had been used. It crossed a stream course that appeared to have been filled. From the air the ditch seemed to have been completely filled, and we came down on the end of that runway at sixty miles an hour, a perfect landing, but to our horror that ditch was fifteen feet deep. I would have lifted the ship, but Mac knew his business and held her to the ground. We leaped into the air twenty feet, we were told, landing on the other side of the ditch on the crippled wheel—smashing it to bits—nothing left but the hub. The ship bounded, staggered, pivoted, and finally came to a stop completely reversed. This was a major disaster, for there were no wheels in Price that could be used. It would take too long to secure another by train, and it was up to Mac to make another wheel, which he did, working night and day; using our own hub, the spokes from several Ford wheels, and parts of wheels from two old derelict ships.

While this repair was going on, an alleged airplane mechanic was instructed to overhaul the magneto. His proved to be a heavy hand, and a broken magneto point was the result. They say that accidents occur in groups of three—now our quota was complete. Finally we were in the air again headed for Vernal, but for two weeks I kept one eye on our vacillating rev-meter until the magneto mishap was eventually repaired. I learned what suspended animation or near heart failure really means.

The Dinosaur National Monument, seen from the air, is another rare sight. Here the upturned edges of Paleozoic and Mesozoic rocks lie exposed on the flanks of Split Mountain like the edges of book leaves—marvelous in coloring and extraordinary in their folding. Many million years of the earth's history are here recorded. At this historic spot many dinosaur skeletons have been excavated and more are to be uncovered so that they may be seen in their natural environment. We found the Emergency Relief Workers enthusiastic and doing a creditable piece of work under the direction of Dr. A. C. Boyle, Jr., the geologist in charge.

The Painted Desert

Finishing work at Vernal, we followed, in general, the course of Green River southward to the Grand Cañon section. In the region of the Painted Desert there is much geological data to be studied. The Triassic exposures in the Painted Desert have produced several valuable specimens in our fossil collection, and for many years it has seemed like going home when I returned to this Desert. In previous years, at Cameron, I had discussed with Hubert Richardson the possibilities of the flat desert as a landing field, so I telegraphed him to prepare a place for us to alight and to put up a wind sock.

It was a marvelous sight, as we followed the rough country southward from Green River around the La Sal Mountains, and cut through Moab, over Mexican Hat, above Monument Valley, El Capitan, and Kayenta. Soon Navajo Mountain appeared on the horizon, guiding our course southward. With a tail wind we were making fast time, and soon the well known landmarks of Red Lake, Tuba City, and the familiar terraces of the Little Colorado came into view.

Never could one forget the sight of Cameron from the air—surrounding red rocks and the swimming pool as green as copperas. Hubert, with the Navajos, had scraped the wind-blown flats north of Cameron, making one of the best landing fields found on our entire journey. One had the impression of landing on a feather bed. Hubert was there to welcome us and, on account of the perfect field, we made Cameron headquarters for several of our lateral surveys, including Meteor Crater, Petrified Forest, the modern Hopi Indian villages, the celebrated Cañon del Muerto, and Cañon de Chelley.

Farmington, New Mexico, was our next headquarters while surveying the Cretaceous and upper Triassic beds in that general region; flying over the famous ruins of Aztec and the plateau of Mesa Verde. At this point Arnold left us, returning to Harvard, taking the 24-inch camera with him, while Mac and I continued our work using the 10-inch camera.

Finishing the Cretaceous and Eocene geological investigations on the eastern side of the Hopi Indian Reservation, we flew southward over the Chaco Cañon ruins, photographing "Bonito" and several of the near-by Pueblos, until Mac cautioned me that gas was getting low, and that we must restrict further maneuvers. We headed toward Albuquerque, and soon a startling object came into view. There below us was a perfectly straight streak, estimated two miles in length and fifty feet wide—part of it crossed by the heads of cañons; plain as a city street, and it had never been reported. I felt sure it was contemporaneous with, and related to the former inhabitants of the Pueblo ruins. I secured several pictures before heading for Albuquerque to refuel and continue on to Santa Fé, where the discovery was reported.

The Folsom Bison Quarry

Our next objective was to secure aërial pictures at Folsom, New Mexico, in order to make a contour map of the Folsom Bison Quarry—one of the keystones in establishing the age of prehistoric man in America. Mount Capulin and the lava country were quickly passed; storms delayed us two days at Colorado Springs, and then on we went to Denver.

The eastern flanks of the Rocky Mountains are too well known to call for special mention, but from Denver northward we were interested in securing additional information on

Jurassic exposures around the Laramie Mountains. It was with great satisfaction that I pointed out the spot on the face of Como Bluff where in 1897 I had taken out the first dinosaur skeleton excavated by an expedition from the American Museum. The section between Laramie and Casper disclosed new data and several favorable exposures in these middle Mesozoic strata that have not yet been explored. From Casper, Wyoming, we again flew over the Big Horn Basin and grounded at Billings, finishing the first section of our aërial survey.

The last half of the aërial survey started from Billings October first, to work in northern Wyoming, Montana, and South Dakota, where smoke had previously interfered. The personnel now included D. A. McIntyre, pilot, the writer, G. Edward Lewis, and George F. Shea.

In south central and southeastern Montana, extensive deposits of upper Mesozoic strata were surveyed and partly reconnoitered on the ground.

Our chief objective in this northern region was to determine with certainty the relationship of lower Cretaceous subdivisions and establish their continuity with beds described around the Black Hills. Until the last lap of the flight the eastern flank of the Big Horn Range had been subjected to only a cursory examination, but a careful reconnaissance from Powder River to the Crow Indian Reservation happily indicates additional fertile fields for future exploration.

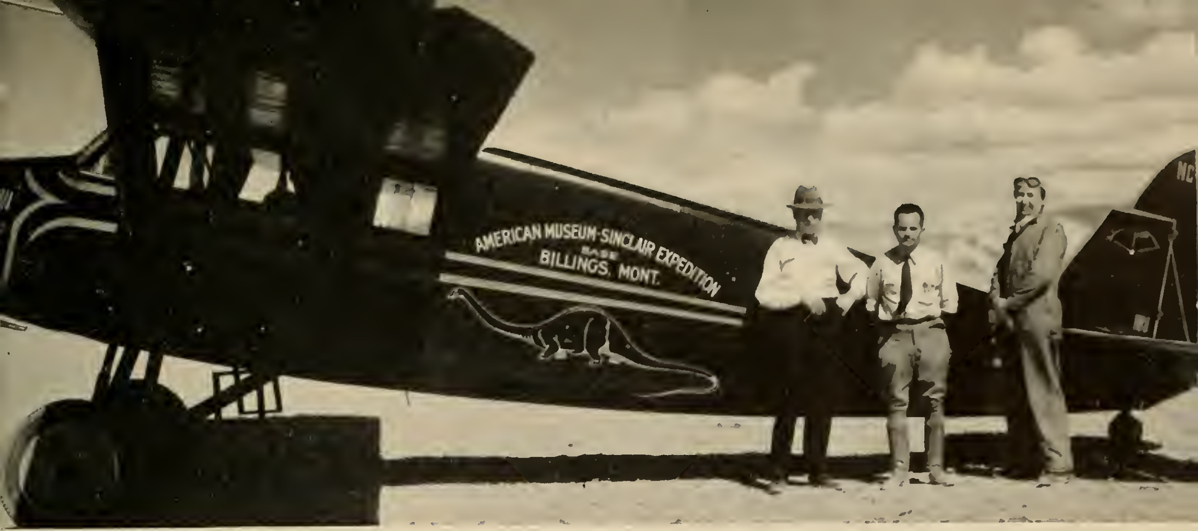
After flanking the Black Hills, we undertook a rapid survey of the classic Big Badlands to the east. The magnitude and sculpturing of this striking topographic feature of South Dakota was accentuated from the air. Here the Cheyenne and White rivers, with their tributaries, have so completely eroded the surface of the earth that from the air it resembles the weathered and wrinkled face of some centenarian squaw on the reservation below.

The last flight of the survey was highly exciting with a low ceiling and head winds piling up great storm clouds on the western horizon. The Big Badlands were soon left behind and our plane headed toward the Black Hills, zooming in and out of the chilly clouds, scudding along at low altitudes, the temperature a scant degree above the freezing point—keeping ice from forming on the wings and forcing the plane down. Fitful gusts of wind tossed the ship about like a feather, but after a surprisingly quick trip, we landed in Sheridan, Wyoming, to refuel. After a fifteen-minute stop we again took off for the last lap, with menacing clouds still lower.

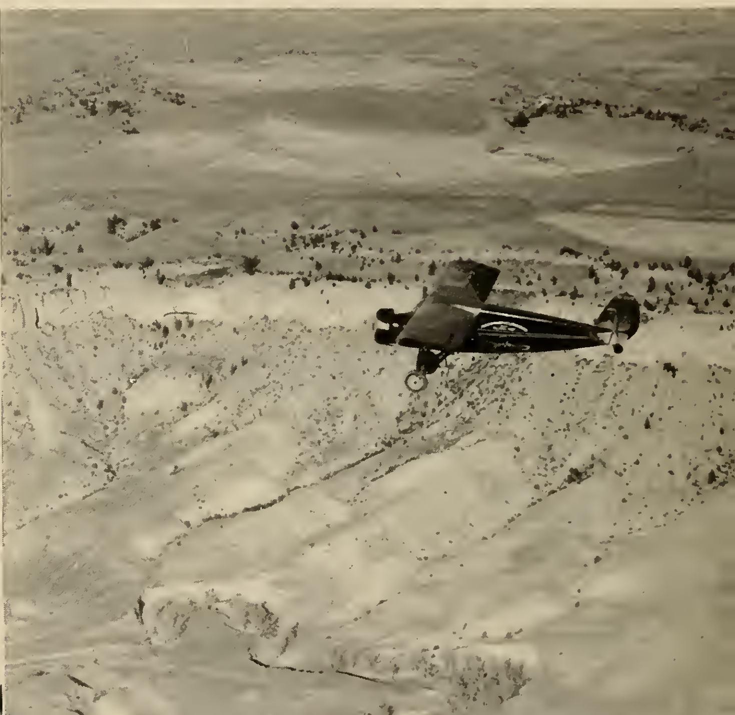
The divide between the Big Horn and the Little Horn was cleared by a scant hundred feet and the plane literally hugged the ground, dodging squalls and circling hills the remainder of the way to Billings, where our six weeks' flight was ended.

Behind us lay 180 hours in the air, over 20,000 miles of the western United States—a highly successful aërial geological survey completed on the most ambitious scale ever attempted.

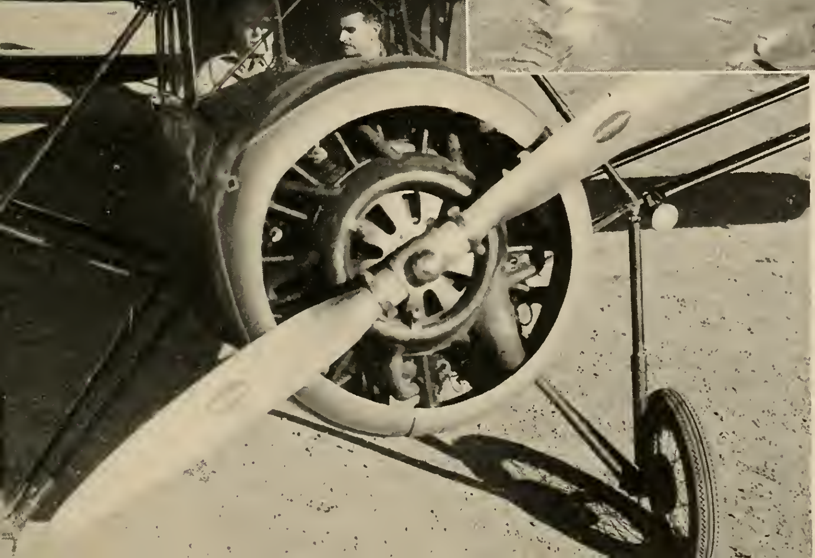
[*Reproduction of photographs accompanying this article is forbidden except by permission of the author*]



The Stinson plane used in the aërial survey, with members of the crew during the early part of the season. Left to right, Barnum Brown, D. A. McIntyre, owner and pilot of the ship, and Weld Arnold, of Harvard University, who handled the 24-inch Fairchild camera. Later in the season G. Edward Lewis of Yale University assisted in photographic work



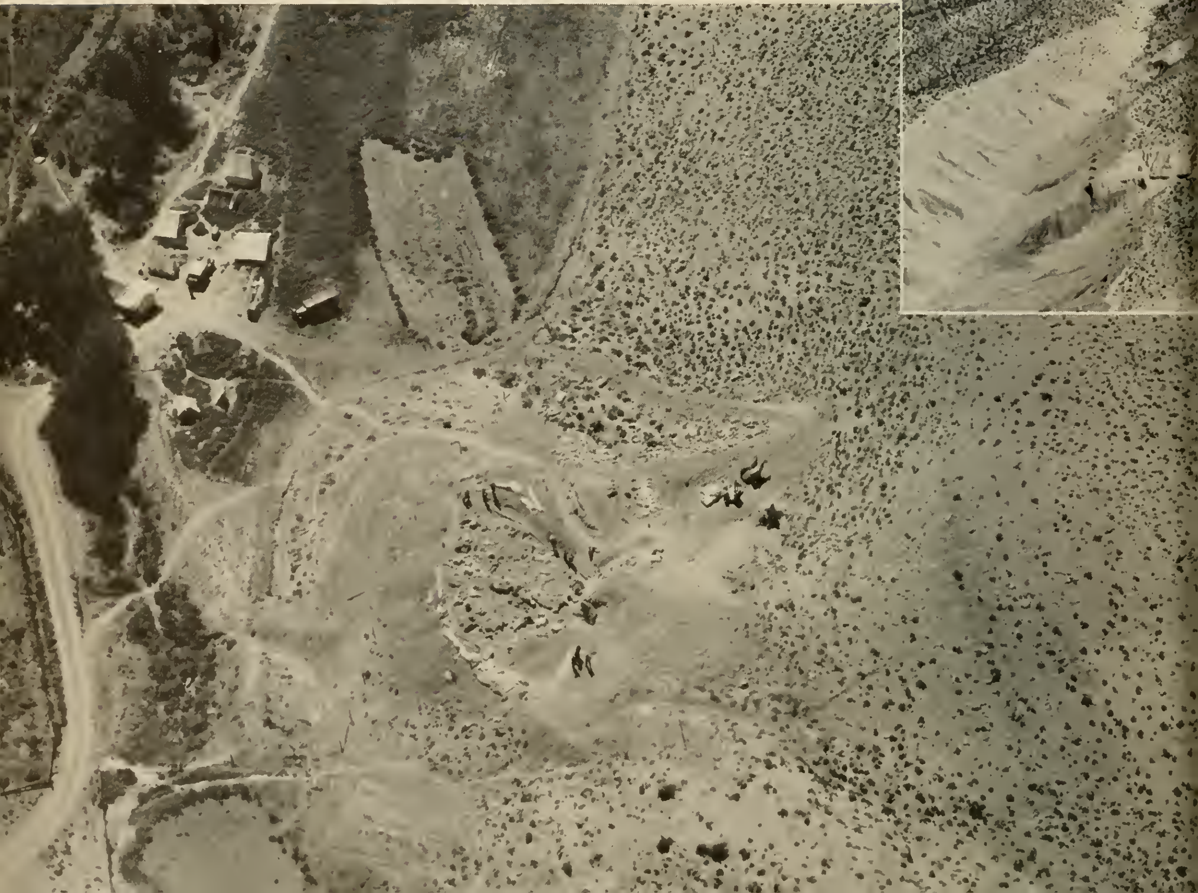
The party at work, flying along the cliffs of eagle sandstone, near Billings, Montana, photographed from a ship of the Wyoming Air Service



The good ship "Diplodocus" ready for the take-off, with Pilot D. A. McIntyre at the controls and Barnum Brown discussing the day's work

(Below) The great dinosaur quarry on the Howe Ranch seen from an elevation of 6000 feet. The bones and the relationship of this great accumulation to the overlying and underlying strata could be determined with the greatest clarity.

This quarry is 65 feet in length and 51 feet in width, and here lie entombed the remains of twenty huge Sauropod dinosaurs where they died en masse as the waters of the lake in which they had lived dried up. Four thousand bones were excavated at this site by the American Museum-Sinclair Expedition in 1934, and the bone mass undoubtedly continues under the hill at the right



Fleecy Reminders of an Ancient Sea

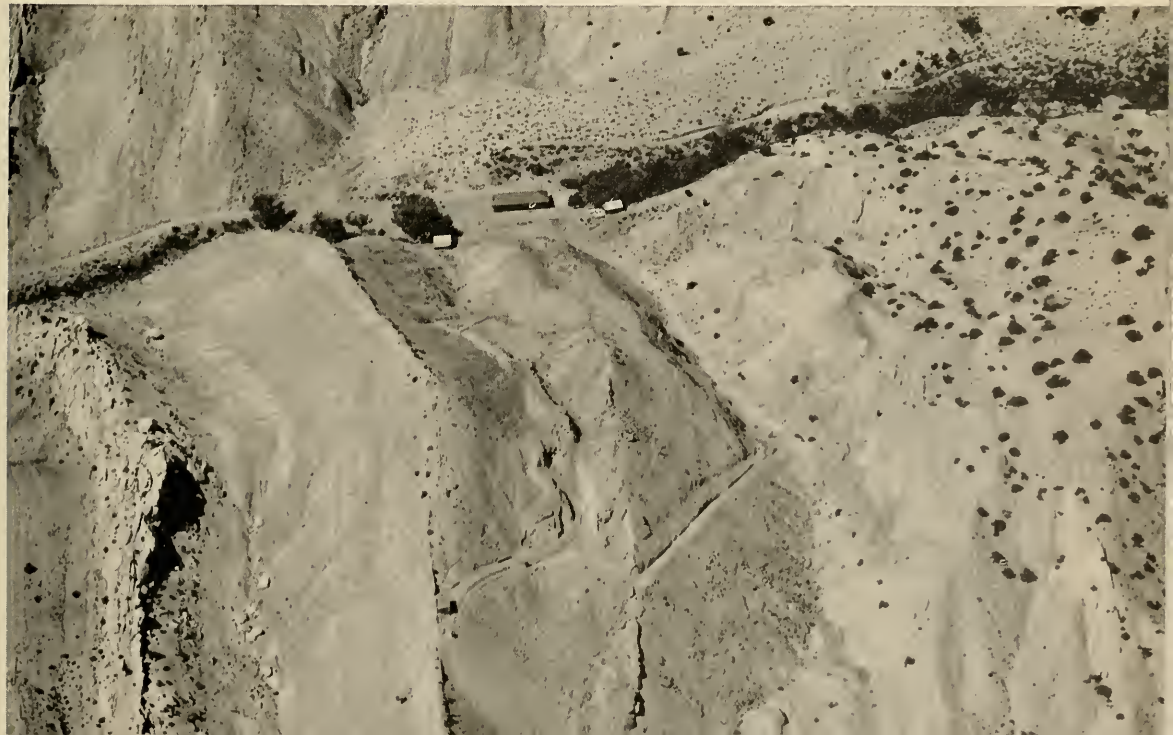
Floating islands of white misty clouds against a background of green ocean shale, with the blue dome of the sky above, made a rare combination of color indescribably beautiful which, fortunately, was recorded. Frequently in the air one is met by a compelling picture, but often circumstances such as insufficient light, or violent storms make it impossible to take photographs

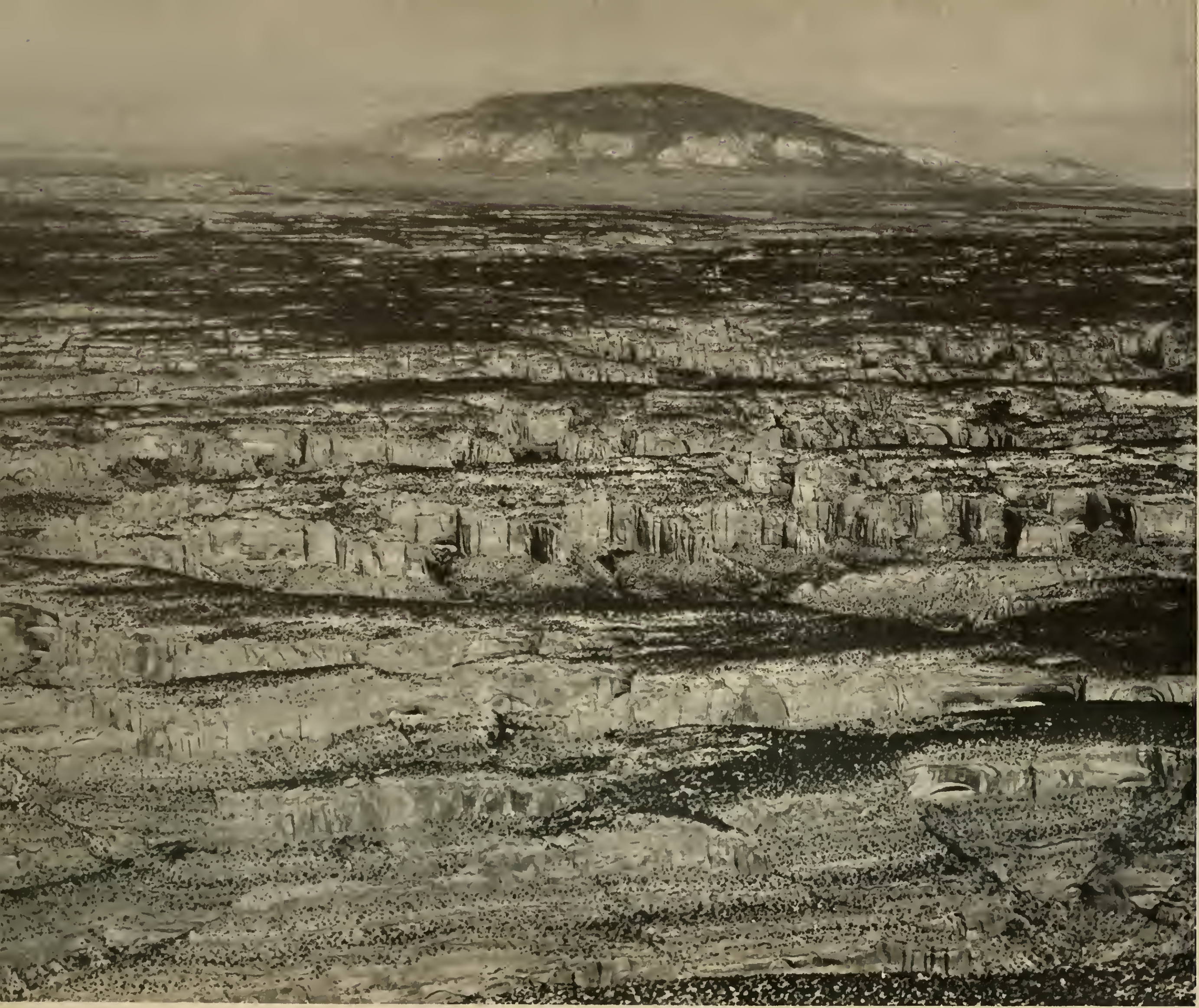
(Above) In the Valley of Shell Creek, five miles northeast of Greybull, the same lateral pressure that elevated Sheep Mountain, seen in the distance, has exposed the fresh-water Cloverly Cretaceous formation in a dome that is rich in fossil remains of early Cretaceous dinosaurs. The opposite half of the arch has been completely carried away

(Below) The Utah Copper Mine at Bingham, Utah, is one of the richest in the world and also one of the lowest grade, only two per cent copper showing in this mineralized mountain. Unlike most mines it is worked in open terraces. Seen from the air, the greenish-blue tone of this impregnated rock presents a rare sight —a large turquoise in matrix setting

(Above) East of Utah Lake, the scenery of the Wasatch Mountains is rugged and picturesque, Mount Timpanagos, at the left, being one of the oldest and loftiest peaks of the range. At the base of the mountain, in the foreground, are remnants of the Provo Terrace, marking the highest point of ancient Lake Bonneville

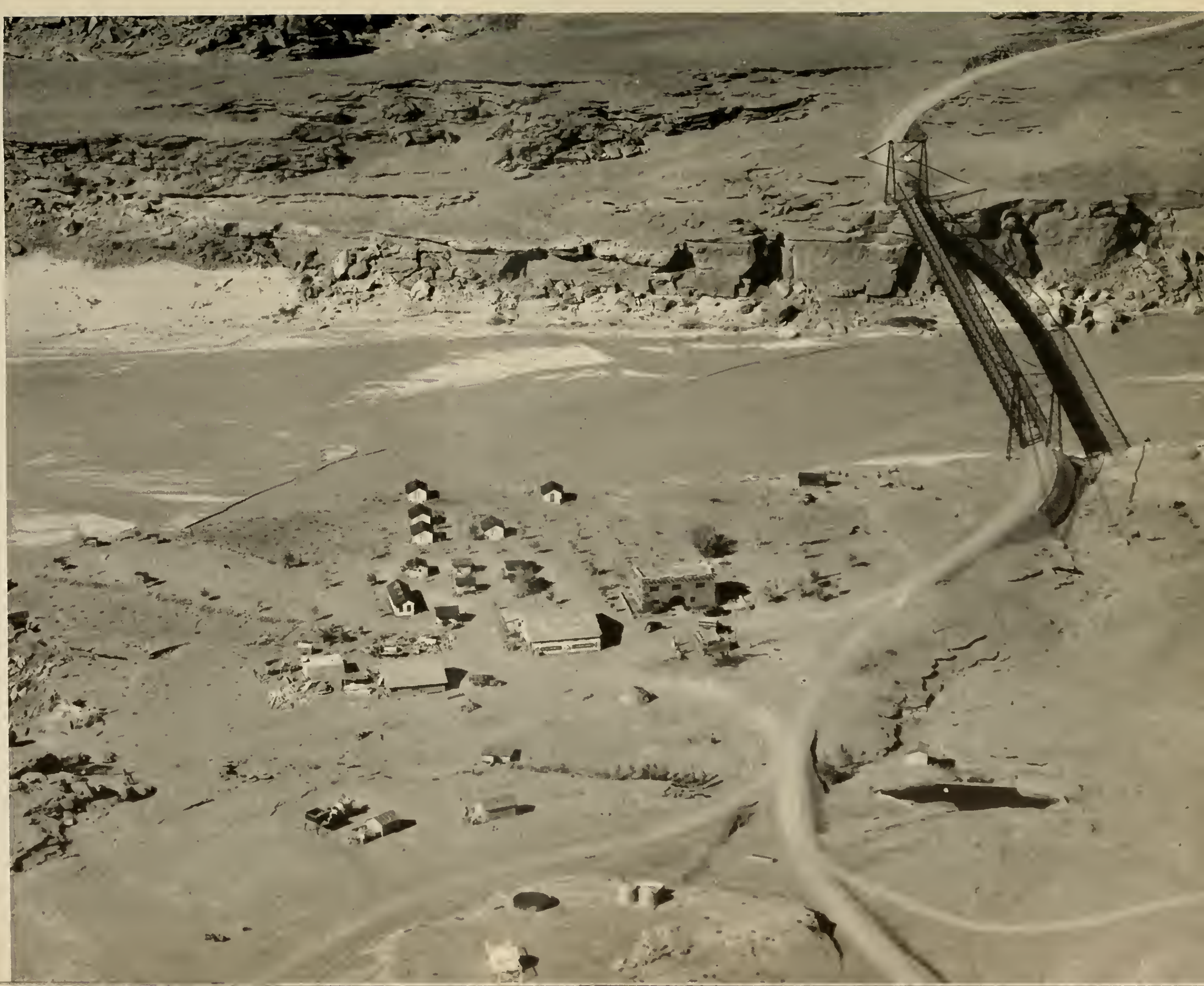
(Below) The Dinosaur National Monument near Vernal, Utah, is planned to be the most interesting of the entire series of National Parks and is to be the greatest in educational value to our touring public. Here, in the upturned strata of Jurassic rocks, are countless skeletons of large dinosaurs embedded in sandstone just as they died 140,000,000 years ago





Prominent near the Utah-Arizona line is Navajo Mountain, conspicuous for a distance of a hundred miles, a guide for airmen, and of great interest to the archæologist. Here on the mountain-side are the remnants of ancient Pueblo buildings dating back to the early centuries.

At the left, in the valley of the San Juan, is the mammoth Rainbow Natural Bridge and in the foreground under the overhanging cliffs, 600 to 800 feet high, are natural shelters, once inhabited by the ancient basket makers, dating approximately from 1,000 to 500 B. C.



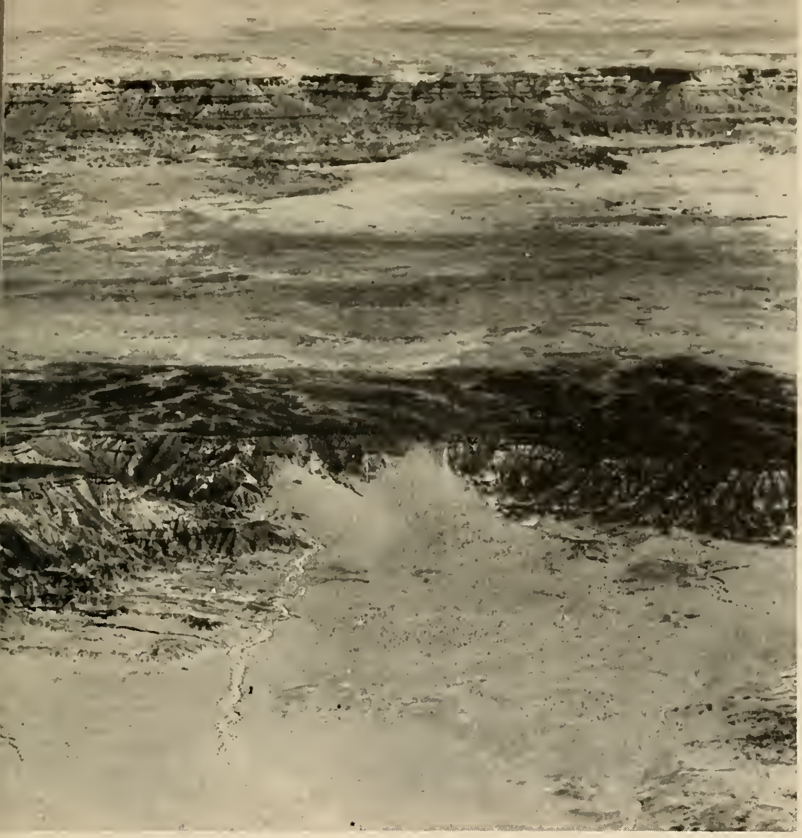
Cameron, Arizona, at the crossing of the Little Colorado River, on the main highway between Flagstaff and Lee's Ferry, is a place long to be remembered by tourists who have had the pleasure of stopping at Hubert Richardson's unique hotel. In no other place can one get a better conception of the Painted Desert, and as the sun makes its daily circuit over the distant cliffs, each sunrise and sunset presents a different series of vivid colors, rivaling those of Venice

Here come the nomadic Navajos to barter their blankets and silver work at the Little Colorado Trading Post, and here also has been the headquarters for many of the motion picture companies while filming their western dramas in the Painted Desert

Fifteen miles northeast of Cameron, Arizona, is the border of the Painted Desert, composed of Triassic strata, rich in colors and in the remains of ancient life. Two distinct mesas or tablelands are distinguishable at this point. In each are entombed creatures of 200,000,000 years ago

PANORAMA OF

(Below) Upper Terrace or Second Mesa. Of harder material than the lower terrace, the beds of rock here have been sculptured into fantastic shapes

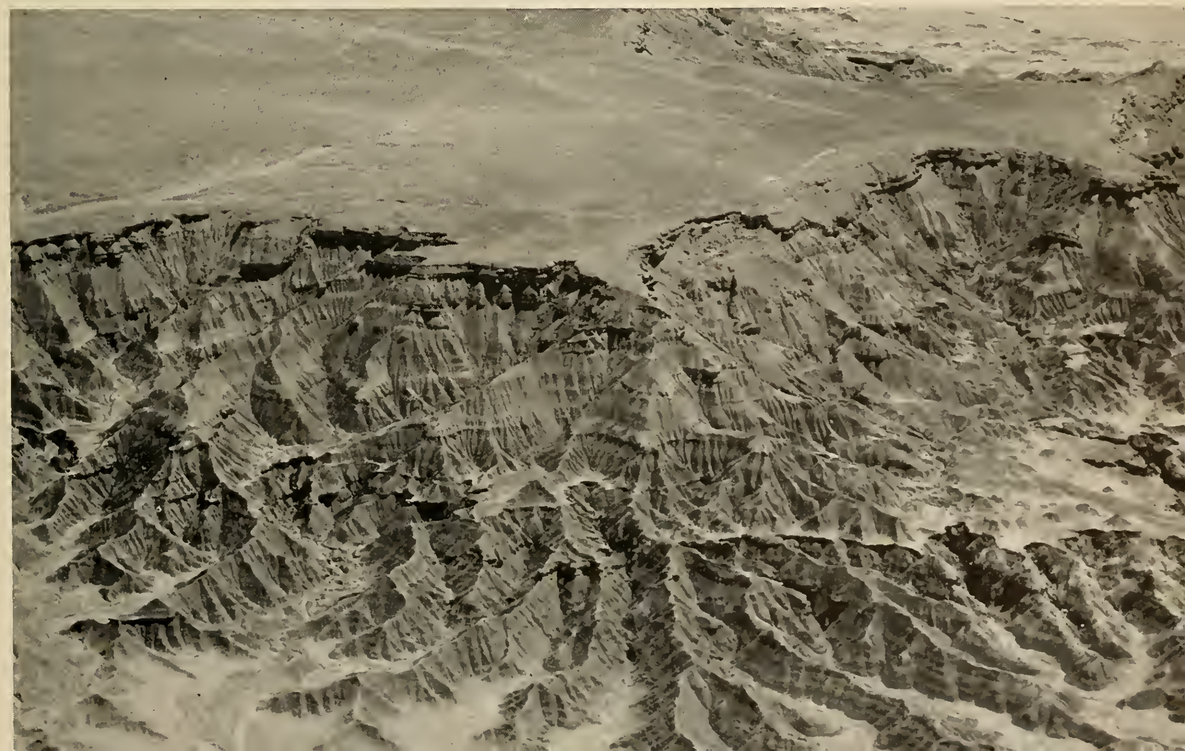


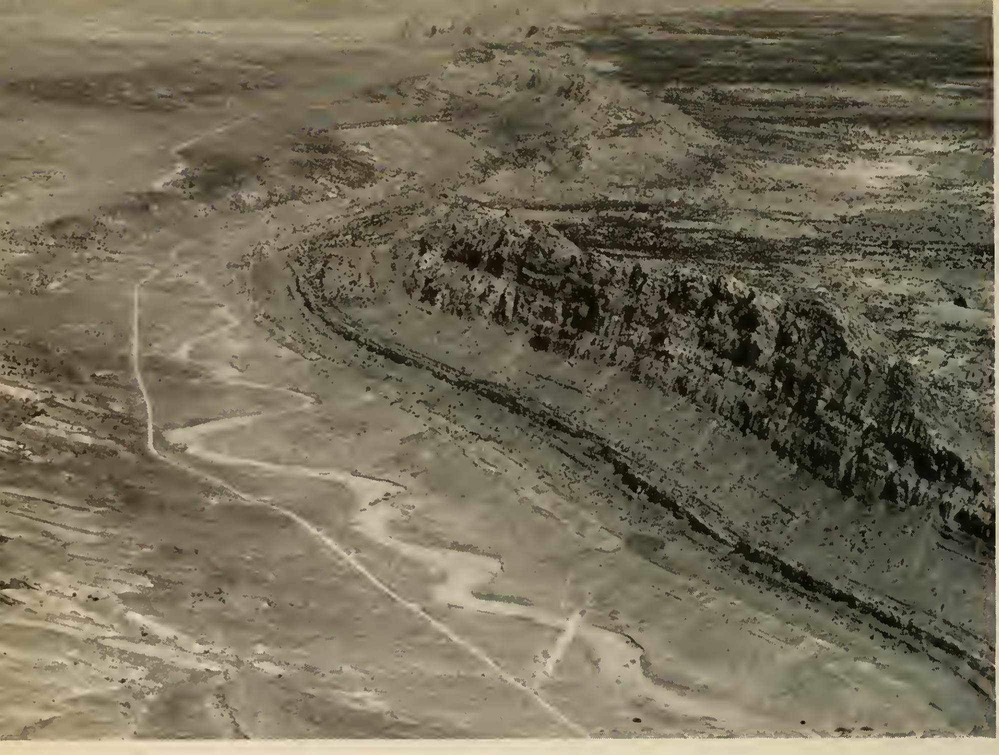
Here are found countless numbers of dinosaur tracks; bones of ancestral crocodiles; phytosaurs; thousands of logs; and many skulls and skeletons of mud-puppy-like labyrinthodonts, or prehistoric salamanders.

More gold than has been minted is disseminated through these beds, but its extraction is still a problem

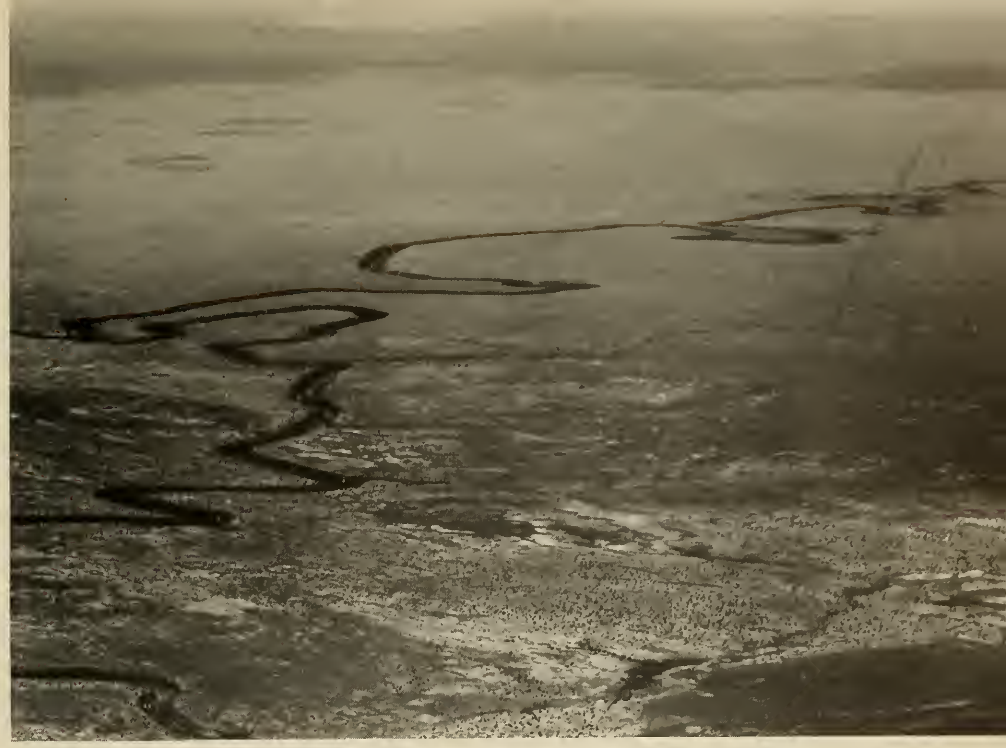
PAINTED DESERT

(Below) Lower Terrace or First Mesa. The coloring is more delicate in these strata, which represent an earlier horizon. Mauve-tinted pastel shades predominate

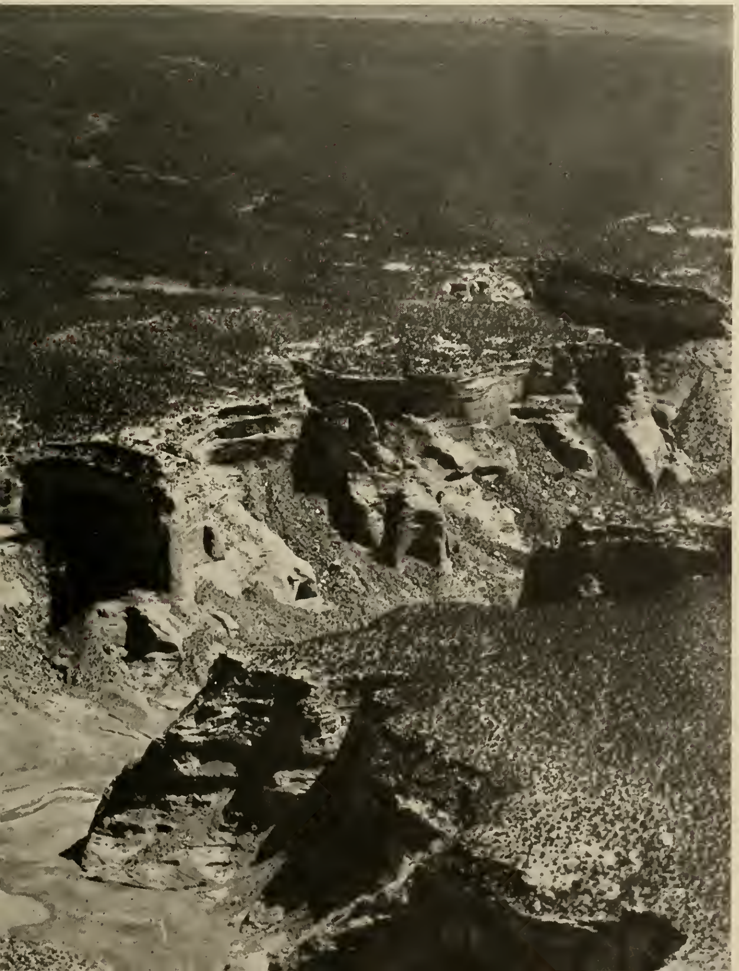




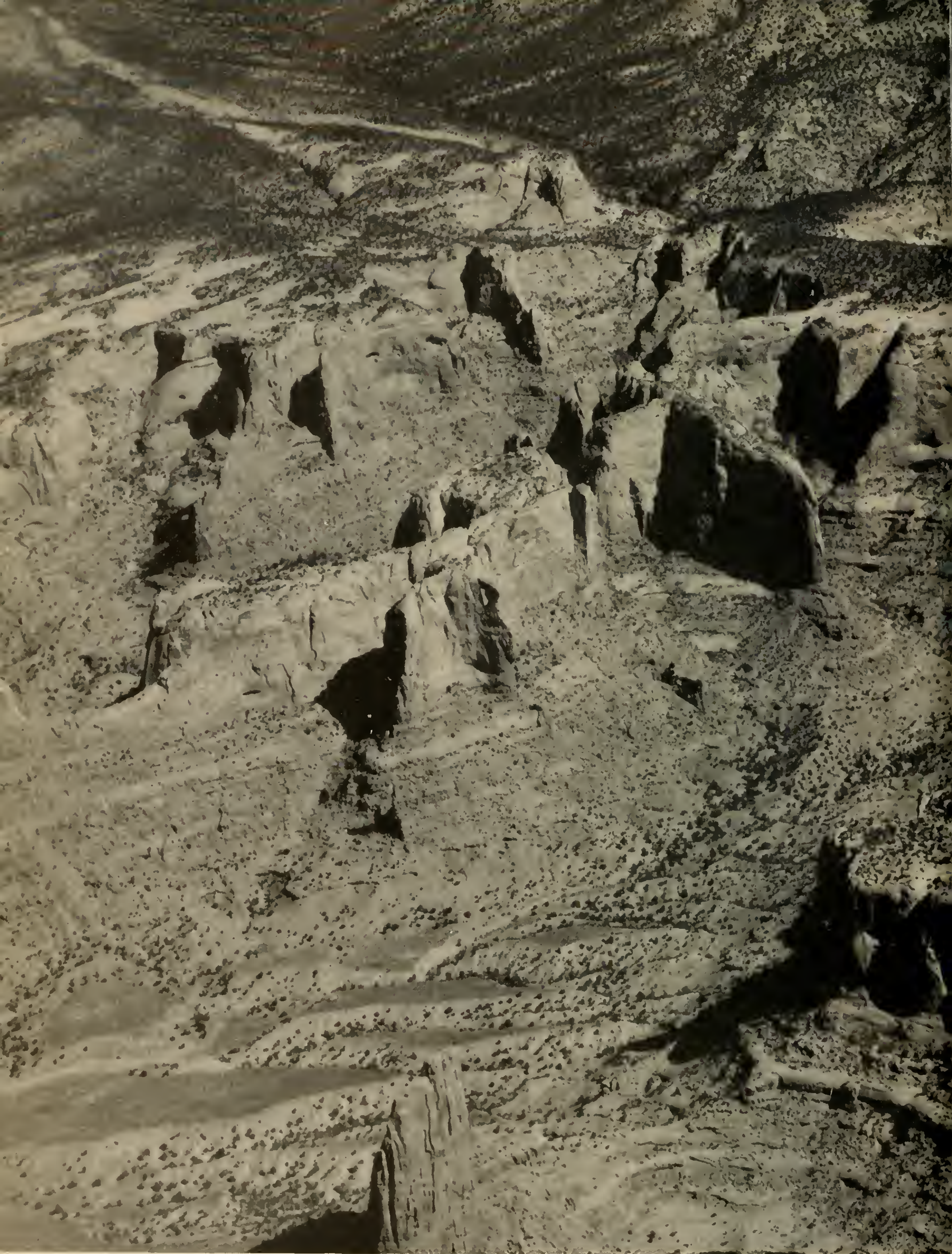
(Above) Halfway between Cameron, Arizona, and Lee's Ferry, on the Colorado River, are the upturned edges of Triassic and Jurassic rocks, forming Echo Cliff that terminates the Painted Desert. The walls of Marble Cañon seen in the distance are the start of the Grand Cañon, which lies to the left, outside the picture. The great highway, recently completed, is a part of the magnificent system of automobile roads connecting the points of scenic interest in the Southwest



(Above) The serpentine, meandering course of Cañon Diablo and its tributaries through narrow, deep-trenched vertical cuts in the solid limestone is strikingly different from water courses through a shale or sandstone country. Comparing it with the Grand Cañon through similar limestone, one sees how the latter has been aided by elevation and spreading

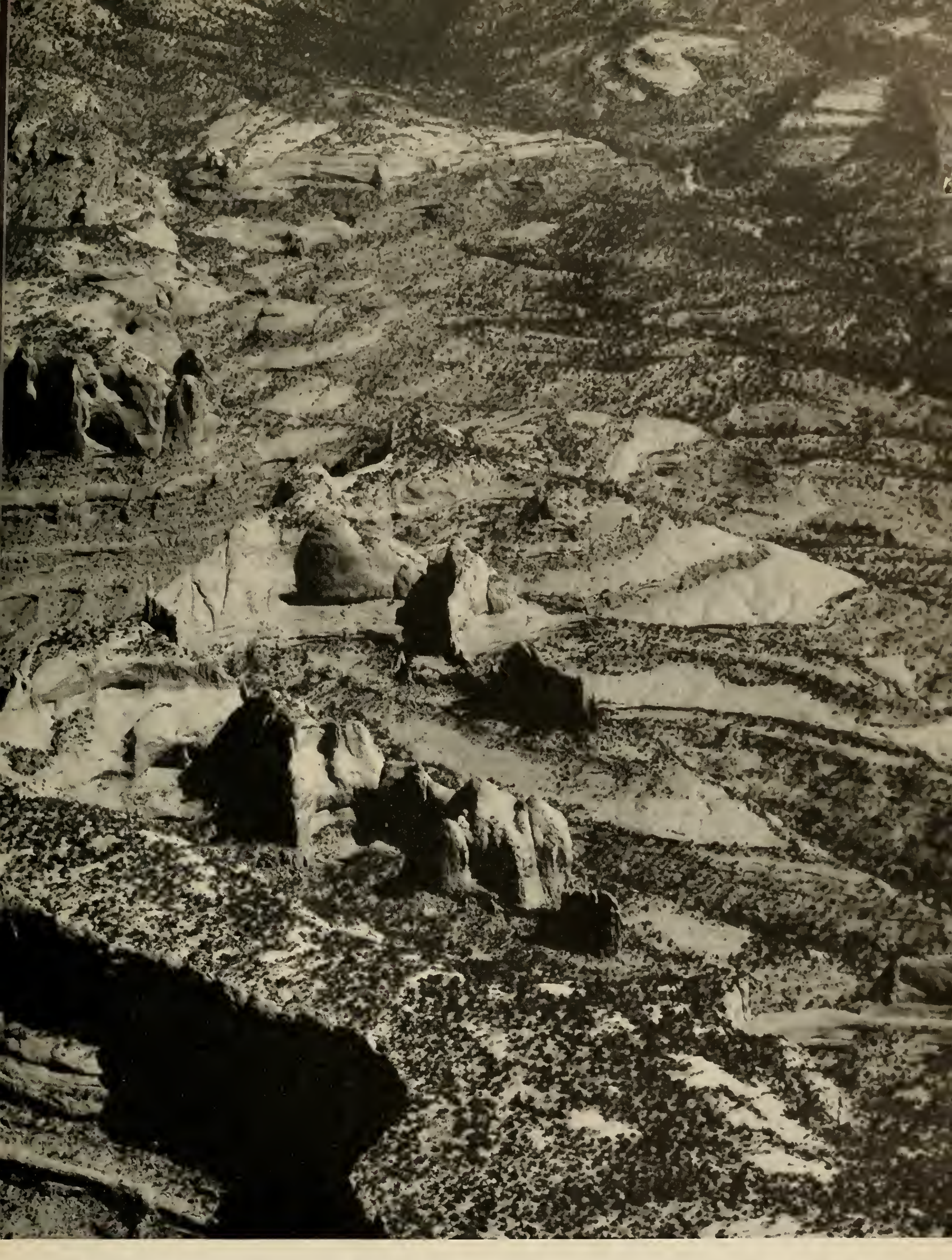


(Left) Cañon del Muerto and Cañon de Chelley comprise one of the most colorful and historic areas in all of the Southwest. Beneath the overhanging cliffs in these cañons, with their 1500-foot sandstone walls, dwelt some of the earliest of the basket makers; here also are found some of the earliest Pueblo structures, and even today roving groups of Navajos cultivate their little fields of corn in the bottom of the cañons. The dark foliage on the plateau is that of sizable pine, piñon, and cedar trees. Romance mingles with tradition in these rugged cañons, alluring to the archæologist, but forbidding to the airman

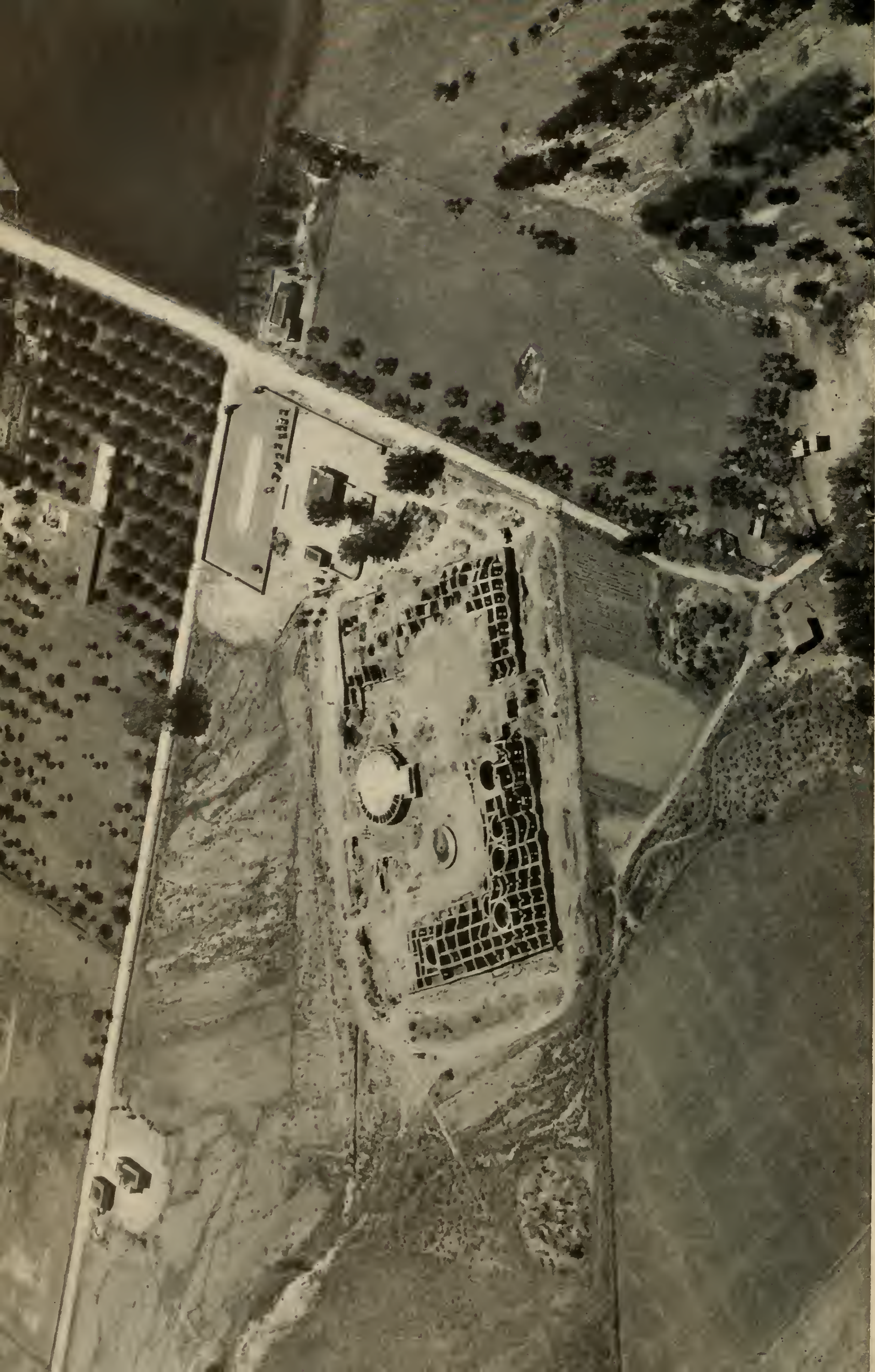


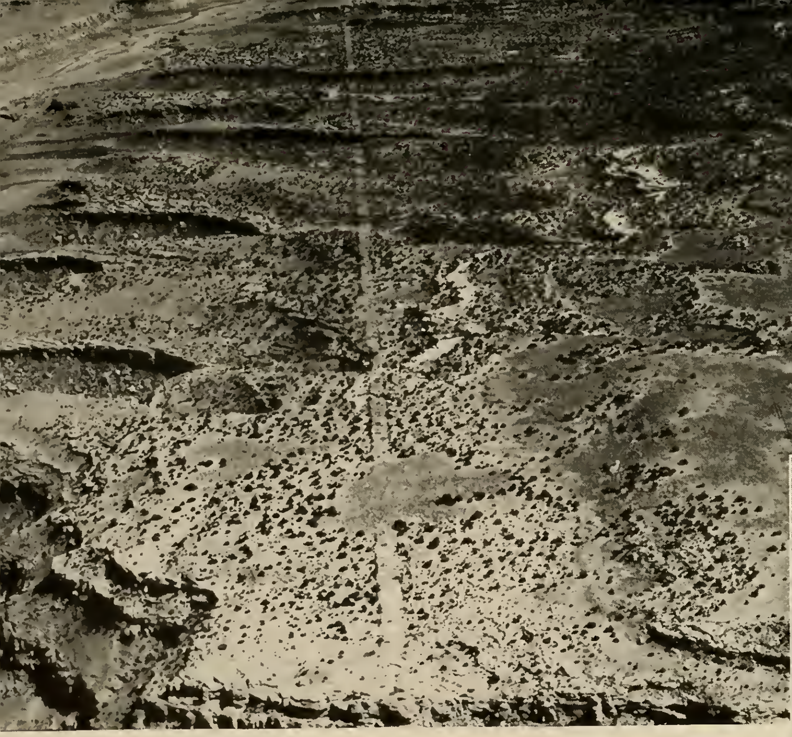
MYSTICAL
CASTLES

There are probably more unexplored basket maker shelters in the Lukachukai and Carrizo mountains than in any other



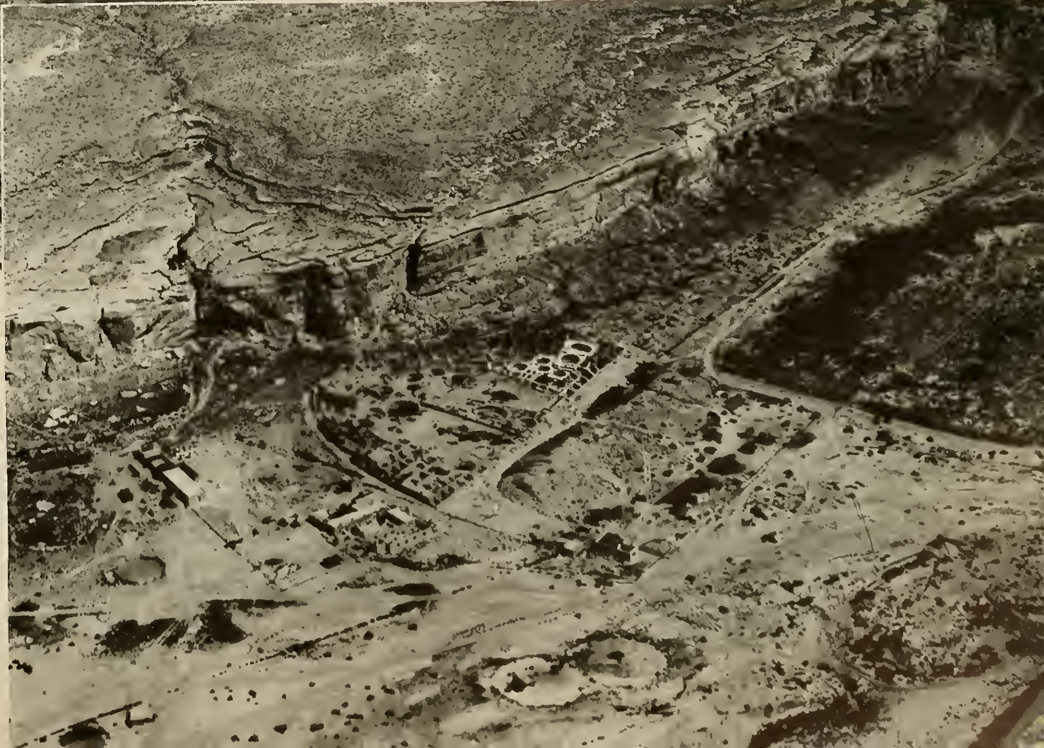
section of the Southwest. Here, in these highly sculptured, fantastic cañons, long before the birth of Christ, nomadic people found shelter under the overhanging sandstone walls and wrested a precarious living from a semidesert country



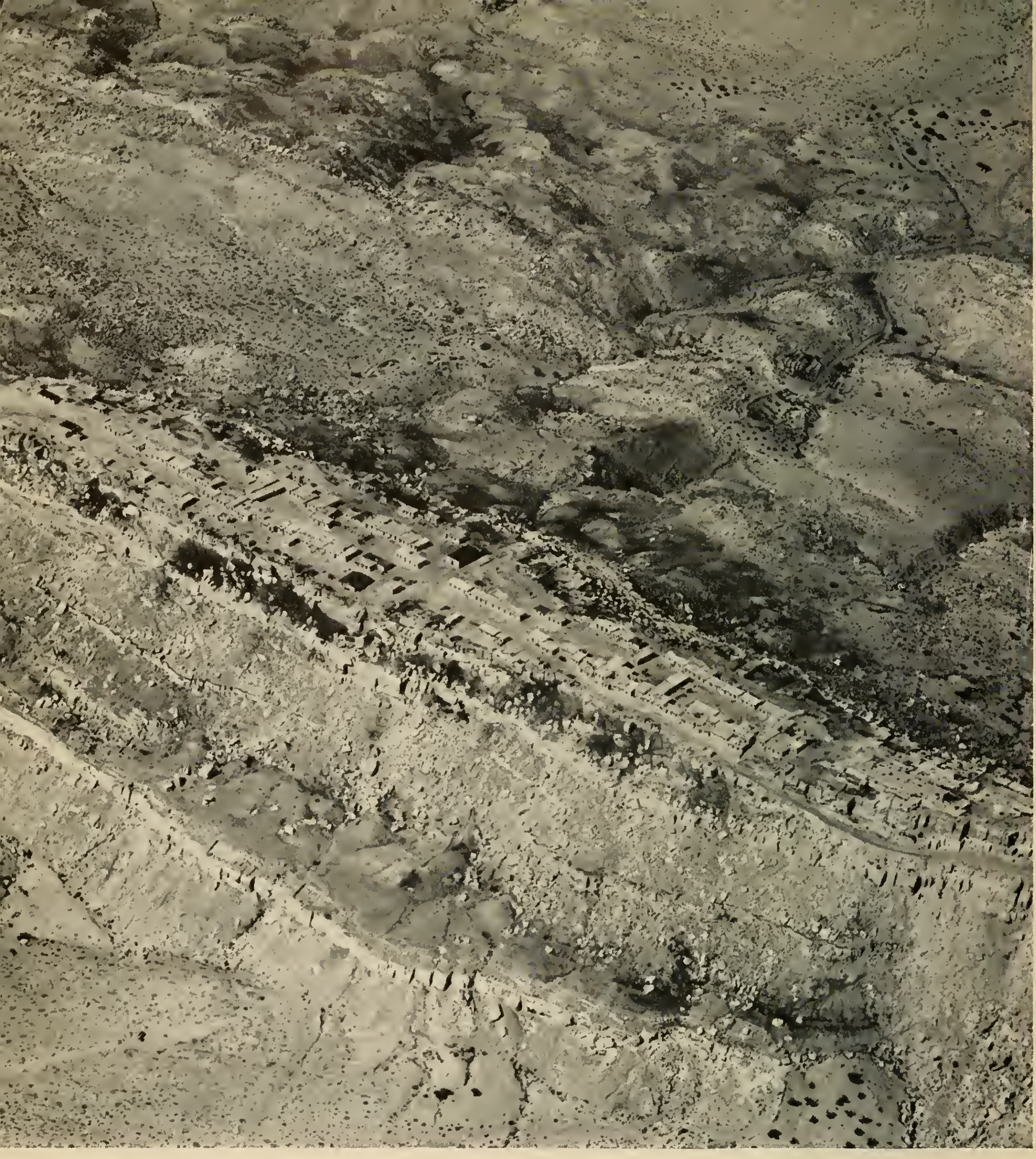


(Picture on opposite page)
Aztec in the valley of the Animas River, ten miles northeast of Farmington, N. M., is one of the best preserved of the ancient Pueblo structures, and also the second largest of these ruins. The tree rings in the rafters of this ancient building show that it was under construction from 1110 to 1121 A. D. The building originally covered an area 359 by 280 feet square and was probably five stories high along the outer tier of rooms. The round, well-like rooms are the kivas, or places for ceremonial meetings. The large, grill-like structure in the open court is the House of the Great Kiva or assembly place for all the inhabitants. This photograph was made in September, 1934, during restoration

(Above) High up on the sandstone mesa bordering Chaco Cañon, near Pueblo Bonito, a long, narrow streak came into view, beginning nowhere and ending nowhere; as plain as a building from the air, but heretofore unreported. It is approximately two miles long and fifty feet wide, terminating opposite Fahada Peak, near the ancient Pueblo ruins, and was evidently a ceremonial way, or race course, used by the peoples who inhabited the near-by buildings



(Right) Nestled in the sandstone walled valley of Chaco Cañon, N. M., are some of America's most interesting ruins, the largest being Pueblo Bonito, which had sheltered at least a thousand people. Ruins of eleven of these ancient Pueblo structures stand near by



THE OLDEST TOWN IN THE UNITED STATES

Walpi, a Hopi Indian village on First Mesa in northeastern Arizona. Timbers in these buildings show that Walpi has been inhabited continuously from before 1400 A. D. *to the present time. It occupies the crest of a high sandstone mesa that fingers out into the valley and rises from the base to an elevation of 200 feet above the plain. Two near-by mesas are occupied by later Hopi Indian villages. Here for generations the timid Hopis have cultivated their corn and grazed their sheep in the valley below, returning at night to their aerie homes*

Living Honey Jars

How the thrifty ant stores food and solves the problems of survival in its complex social organization

By A. C. Cole, Jr.

On busy city streets and walks, in velvety lawns and gardens live myriads of ants struggling for life in an ever-changing habitat. Tiny brown and black pavement ants, the larger and more fierce carpenter, shy little *Myrmica,* greedy sweet-adoring *Monomorium*—these are common city dwellers. Here nest building is difficult and the procuring of food even more so. Man's domain leaves little room for others, and those that survive human destruction are usually in some way dependent upon man or his activities.

But out in the open spaces millions upon millions of ants live and thrive in unbounded freedom—in green fields and shady woods; broad deserts and high mountains; vast plains, moist meadows, and steaming, tropical rain forests. There they find food in abundance, ample space, shade-giving plants, sand and moist soil for nest building, and rocks for protection. In the mountains and deserts live thrifty honey-bearers, bold hunters, busy seed-gatherers, crafty thieves, and prosperous fungus-growers, some in mounds, others beneath stones, and many in plants.

Mound dwellers

Tramping along the stony ridges of Colorado's Garden of the Gods or meandering on the higher hills about Prescott, Arizona, the observant nature lover or the interested wanderer will perceive rocky, conical mounds, with a single large and irregular hole in the top of each. He may even notice, especially at twilight or possibly even after dark with the aid of artificial light, the small, opaque, lemon-yellow occupants of these mounds. He may see the endless stream of legs and soft bodies twist and glide along the routes that lead to and from the nests. These are honey ants, scientifically known as *Myrmecocystus horti-deorum.*

Perhaps the observer is curious and wishes to see behind the barrier of stones and soil, to scrutinize the inner mechanisms of the colony. A kick of the boot would destroy the mound sufficiently to expose part of its hidden galleries and disclose some of the internal architecture, but how much more interesting and profitable would be a careful removal of the masonry, pebble by pebble, one bit at a time.

Underground chambers

The ants swarm out of their subterranean chambers helpless to protect their home from the human invader. If the investigator is patient, he is only slightly annoyed by the hundreds of small legs crawling upon his hands and arms, and need pause in his operations only long enough to flick one of the more venturesome creatures from his neck or forehead. For, differing from some of their cousins of the deserts and plains, these ants do not sting or bite.

Even after the entire mound has been leveled, the investigator has had only a superficial glimpse of the home of this little insect whose real achievements lie buried deeply beneath the soil. Careful digging uncovers rude chambers, some large, some small; some with busy ants in them, others with masses of tiny, soft, white grubs. The ants which were seen running to and from the nest were the workers—sexless individuals often called neuters, but more correctly known as sterile females, comparable to the worker bees. They are the providers of the nests, the protectors of their colonies and maids-in-waiting to their queen-mother. They are almost continually active, whether on their food-gathering forays far from the nest or protecting and attending to the wants of the colony. They are responsible for the nutrition of the helpless grubs or larvæ, from which more adults develop.

These grubs are peculiar little bundles of flesh quite unlike their grown sisters and yet so dependent upon them for care. Each larva, a composite of tender segments, tapers at the end; each is legless and has a small and hardly discernible mouth. Only a fleeting view may be had of the brood, for, as soon as the roof of the chamber is torn away and the grubs exposed to the light, their worker nurses, with powerful yet gentle mouthparts pick them up and scurry into deeper chambers of the nest to deposit their charges once more in temporary security. Even under natural conditions, when the nest is not tampered with or disturbed in any manner, the workers move the brood from chamber to chamber as may be required by changes in temperature and moisture.

Recluses from the outside world

With a trowel the examiner may dig deeper into the soil until finally his instrument penetrates the roof of a comparatively large chamber where soft tumescent bodies tumble to the floor much in the same manner as "humpty-dumpty." But, if he is fortunate and cares to make several attempts, he finally opens one side of a chamber where he finds arrayed upon the ceiling more of the clumsy, pot-bellied animals which he had discovered shortly before. These are surely not workers, he surmises; yet his assumption is somewhat incorrect, for they are in reality workers with highly specialized though peculiar tasks. Known as repletes, they are the honey-bearers or honey-storers of the colony. Their huge, awkward abdomens contrast greatly with the rest of their bodies, which are like those of the workers. They never leave the nest, for their bodies are so swollen that their legs cannot touch the ground. With bellies so gorged with "honey," they are life prisoners in their own home—recluses from the outside world.

If the observer is sufficiently interested, he should prick with a pin or something else suitable, the abdomen of one of these repletes. Immediately upon doing so the "honey"—not true honey at all but a thin, almost colorless and semitransparent liquid—gushes out, leaving the ant's abdomen deflated and limp. The liquid is rather sweet to the taste but lacks the flavor of the honey of bees. By a regurgitation process the workers transmit from their own mouths to those of the repletes liquid food which they have procured in the course of their daily foraging. The repletes thus are specialized for the function of storing the "honey," so that it can subsequently be utilized by all members of the colony, young and old alike.

Perchance the investigator may wish to dig deeper into the nest to see whether he has overlooked anything of interest. If he is persistent enough, though his patience may be tried to its very limits, he may eventually uncover and examine the most important member of the colony—the queen, mother to all in her little domain. She is wingless, much larger than the workers, and lacks the distended abdomen of the repletes. She is an offspring of another colony of the same species. Without the queen her colony would be eliminated. Her sole duty in the nest is the deposition of eggs, and from the time her first ones hatch to the time of her death—normally a matter of several years—she is the most honored and respected member of the entire colony. She is continually protected from danger by her workers, and only rarely does she venture to the surface of the mound, crawl fearfully outside, gaze at the outer world disapprovingly, satisfy her innate feminine curiosity, and hastily retreat to her protective subterranean chambers. The workers are ever at her command, in times of peace or of war.

The nuptial flight

It may be that the observer has chanced upon the proper season of the year to see other curious members of the colony. If so, he is attracted by winged individuals which crawl about but do not fly. He may marvel at the rapidity with which they move about on their long, slender legs alone. He may wonder of what use are the wings or indeed any of the winged creatures. It may occur to him that here are the males and females, the true sexes themselves, some of which, if the wings were absent, would distinctly resemble the queen, and would, in fact, be almost indistinguishable from her. But there are forces of which the casual investigator would not be likely to have knowledge. These males and females developed from eggs long since laid by the queen. They, too, passed through the same stages as the worker, from tiny, white, legless larvæ which hatched from eggs, through their transformations to the adult form—fully grown, fully matured. In them are vested the essentials of new life exactly as in the sexes of the human race.

And now, if the observer is persistent and visits the nest daily for a time, he may be so fortunate as to witness the wedding or mating flight of the ants. At last the males and females make use of their wings. At this time only are these important but transitory appendages enlisted into service. In great streams the ants leave the mounds, rise into the air, and gaze upon a world unknown to them. In these fantastic swirls they mate, each female with a single male. After each mating is completed, the female drops to the ground. The males, having fulfilled the sole purpose in life with which they were endowed by Mother Nature, fall lifeless to the ground, where they are scattered by the wind or ruthlessly grabbed for food by foraging ants.

Settlers of new domains

The females fare differently and are in many ways more fortunate than their short-lived mates. In them only lies the power of distribution and the propagation of the species. After they have descended to the ground, often at great distances from the mother colony, and when they have excitedly maneuvered in all directions on their new homestead, they chew off their wings, an instinctive action which appears almost purposeful. These appendages have become utterly useless and, if allowed to remain, would only handicap the ant's activity, which for a time is intense. No longer are these insects virgin females, protected and nurtured by their sterile sisters. Now each is a queen, a potential mother and a lone settler of her new domain. Freed of her wings, with feet and mandibles working furiously and bundles of muscle tense with action, she carves from the unbroken soil a small superficial chamber, the incipient beginning of her future nest. The entrance to this is marked only by a little pile of fine soil, the by-product of her labors.

In this chamber she rests and after a time deposits several dozens of minute eggs tightly massed together. It is the queen's duty to care completely for the needs of the tiny grubs which hatch. This is her first brood and from it emerge a number of workers, her first tireless servants and providers.

Propagation and distribution

The burden removed from the queen's strong shoulders, she is now able to rest in security and to leave to her trusted offspring the duty of enlarging the nest as well as of protecting and feeding her while she lays new batches of eggs until her earthen palace contains hundreds and finally thousands of busy ants. When the proper time arrives, some of her eggs develop into males and females, and the endless processes of propagation and distribution are carried on and on.

This is the reason the observer finds the numerous colonies; this, why he may travel from the Garden of the Gods to Prescott, and from there into the lower desert plateau near Phoenix and yet see the same species.

Only seldom, however, is a mound of *M. horti-deorum* found in the desert proper; few have been able to contend with the hostile environment to the extent of thriving, and they have been unable to disperse as widely as their relatives of the mountains. In the desert they are replaced by other species of their genus, shining little *semirufus* and its larger but less colorful relation, *mimicus*. *Semirufus* and *mimicus* spend a busy life in the hot desert sands where environmental conditions are not so unfavorable for them as for *horti-deorum*.

So much for the life-history and habits of this interesting honey ant. But the honey ants represent only one group of the large ant family. Ants of other groups possess different habits, so different in fact that there is real similarity only in biological development, which is much the same throughout the entire family. Many ants live beneath the bark of trees, some in stems of plants, others within plant galls, and a large number in nests beneath stones and in the nests of other ants.

The Occident ant, for example, a fine and prosperous species of the family, is a tireless harvester that inhabits conical pebble mounds on the plains and in the semideserts of the West. It clears away plants from around the mounds, and gathers large stores of seeds during its foraging tours. It defends itself with an excruciatingly painful sting and a pair of sharp and powerful mandibles or toothlike structures surpassed in size only by those of its closest desert relatives. There are records of the stings of this ant killing pigs and calves, and a venturesome field mouse has little chance of escaping with his life. Only the horned toads—which are lizards in reality—are able to squat on the mounds and consume great quantities of the angry inmates. The horned toad offers an impenetrable skin to the ferocious bites and merciless stings.

Other ants and their ways

Then there is the little brown ant, *Lasius*, the cornfield ant of the farmer's domain. It protects aphids, or plant lice, in return for the much prized honey-dew which they freely afford. The aphids are carefully guarded and expertly maneuvered by the workers of *Lasius*, and are placed upon the most choice roots in the ants' nest or of near-by plants. In exchange for this protection and food the plant louse exudes from its abdomen drops of sweet honey-dew which the hungry ants lap with gusto. This is a perfect communion of ant and louse, two distinct and rather distantly related members of the insect class.

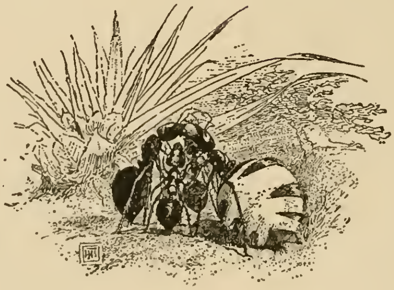
Tiny *Solenopsis molesta* is an interesting insect. Known as the thief because it lives on the stores in other ants' nests, this minute yellow creature builds its small tunnels and galleries among those of its "host" ant. Its existence is dependent upon the other ants, and it is thus the veritable robber of the ant family. Strange to say, however, it is tolerated with good grace by those ants in whose homes it lives. In fact, small notice is taken of the sluggish little fellow who roams from gallery to chamber in quest of stored dainties.

Some ants (*Formica* and *Polyergus*) raid nests of other and closely related species and carry back to their colonies workers which are subdued and used as slaves. So subservient do the captives become that they help raise the young of their captors and contribute to the general routine of their new home. Soon they come to live in complacent harmony with their surroundings and are as much at home as their subduers.

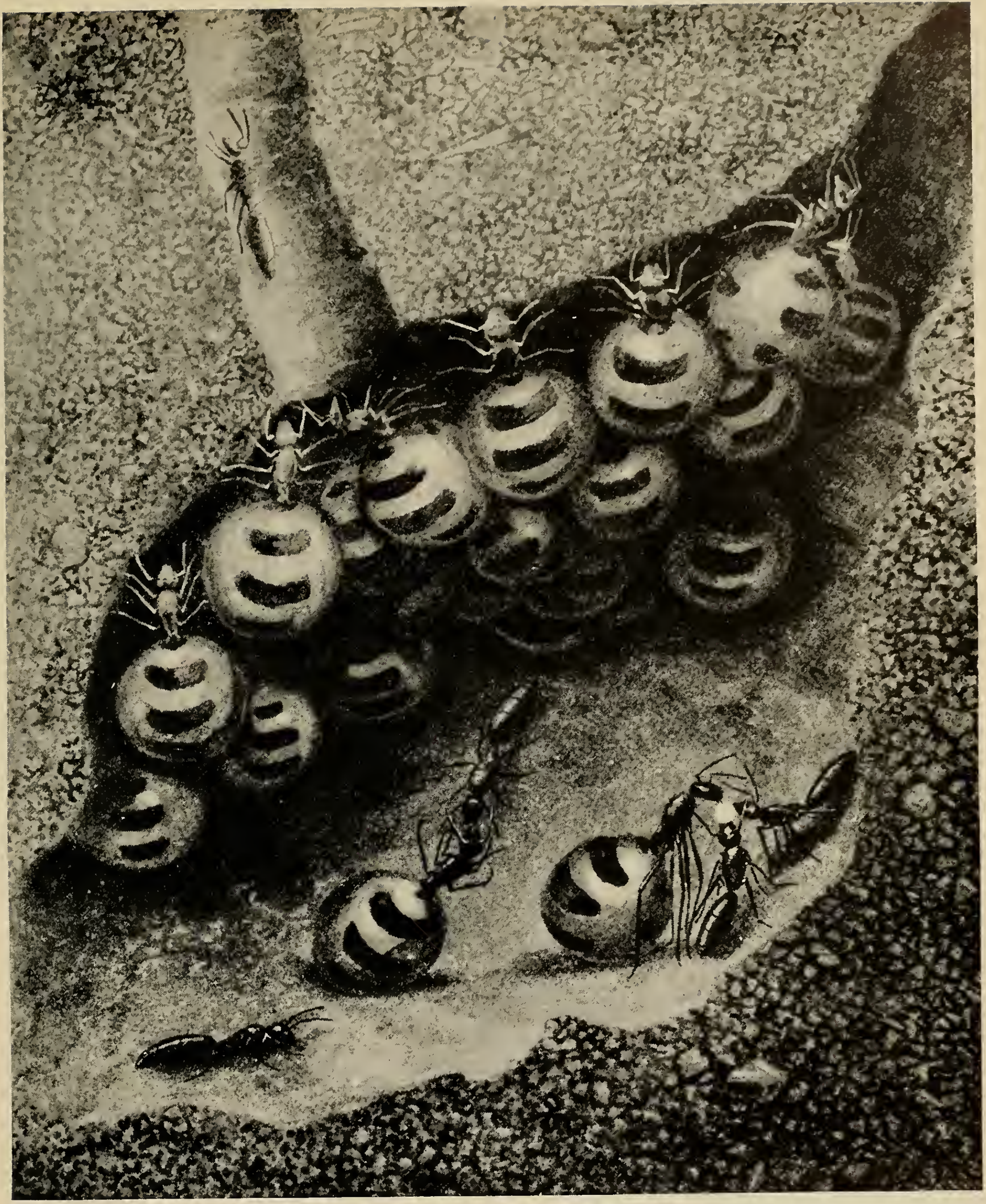
Another ant whose habits offer sufficient interest and distinction to make it worthy of biographing is grotesque *Atta*, with sharply buttressed head and thorax and spiny armature. Peculiarity in appearance and individuality in habits characterize this fungus-grower. Instead of gathering seeds, as does the Occident harvester, instead of thieving like *Solenopsis*, for example, she cuts and gathers bits of green leaves. With expert manipulation *Atta* transports the leaf particles to her nest chambers well beneath the surface of the soil. There they are thoroughly masticated and deposited upon the floors of the larger chambers. Carefully tended by the ants, these fertile bits, planted with spores, give rise to a luxuriant growth of fungus, abundant provender for the colony. So develops the food of *Atta*, and thus does this species take advantage of Nature even more than do many of her relatives.

Many ants remain to be discovered; many of their life-histories need be studied. In deserts and on mountains, in forests and on plains, new species are constantly being found, the eccentricities of their behavior divulged, and their relations and interrelations brought to light. Each new form is an asset to our knowledge of the family and a contribution to the vast study of social animals.

Much has been written of the intelligence of ants; much controversy has resulted. Be this as it may, the mere fact that ants are social insects of a high order enlivens our interest in them and in their struggle for existence.



A honey-bearer in the act of regurgitating food to workers of the ordinary form. From "Ants" by W. M. Wheeler



From "Hutchinson's Animals of All Countries"

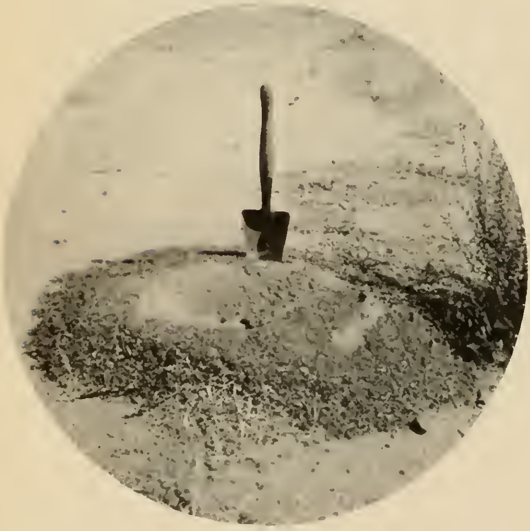
IN THE HONEY CHAMBER

The honey-storers cling to the ceiling of the honey chamber, their honey-crop swollen out of all proportion to the rest of their body. They never leave the nest, for they are too heavy with honey to walk about, thus becoming life prisoners in their own home for the benefit of their comrades

Photograph from Ewing Galloway

Nearly all of the honey ants are confined to the dry plains and deserts of North America, South Africa, and Australia. On these rocky slopes in the Garden of the Gods, Colorado, the honey ants nest in comparative security

Homes and Habitats



(Above) Here Atta versicolor *has constructed her nest beneath the limb of a thorn bush in the desert near Phoenix, Arizona. In the subterranean chambers are her fungus gardens*

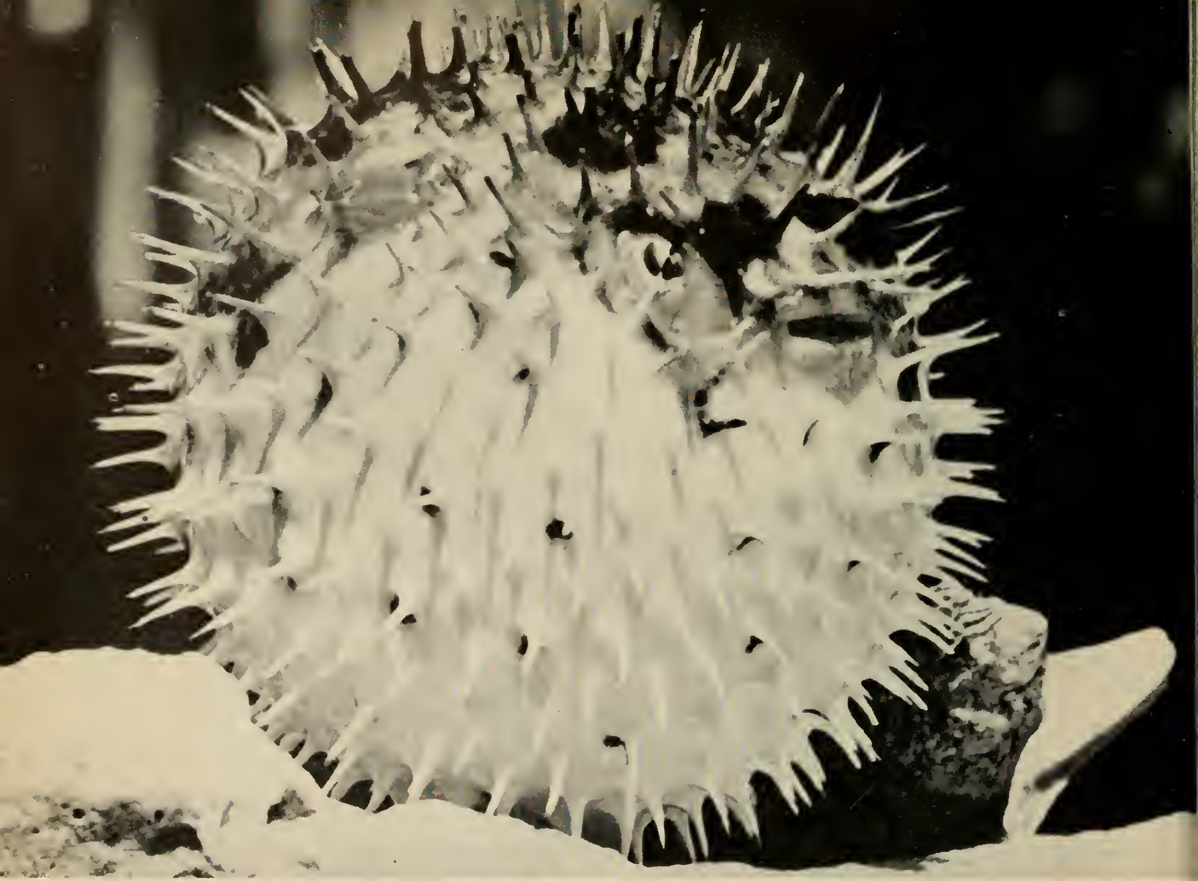
(Left) A nest of Novomessor pergandei André *in the Mojave Desert, California. The periphery of the mound is covered with chaff from harvested seeds*

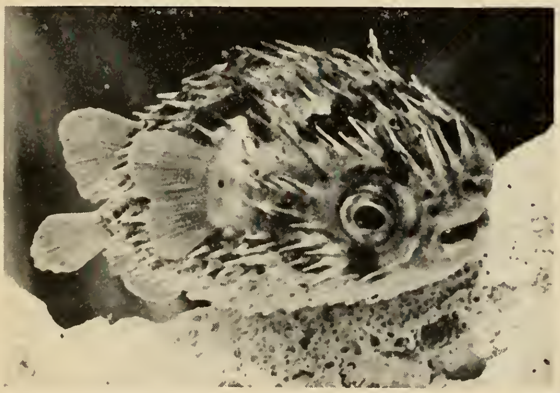
(*Right*) Dorymyrmex *is one of the most successful desert dwellers. Note the fine sculpturing of this mound found near Mojave*

(*Below*) *The little brown ant* Lasius *lives in small crater nests such as those shown in this photograph taken in Zion National Park*

In the Arizona desert. Atta *often cuts the small leaves from the spiny stalks of the desert shrub ocotillo at the right in the photograph below and transports them to her fungus gardens. Many ants live in the pithy trunk of the giant cactus shown at the left*

Photograph from Ewing Galloway





(Above) A porcupine fish puffed up. The porcupine fishes occupy an enormous territory in the tropic seas of both the Atlantic and Pacific oceans, reaching Florida, Bermuda, and Southern California

(Left) A porcupine fish at ease. This Diodon *was captured in a fine-meshed seine that was pulled along the shoals near a fine stand of live coral heads at Loggerhead Key, Florida*

(Right) In the distance is Loggerhead Key, the home of the porcupine fish. This is the last of the Florida Keys and is one of the series of the Dry Tortugas. The Carnegie Institution of Washington maintains a marine laboratory on Loggerhead Key

Fishes in Armor

Protected from greedy sea marauders by a coat of sharp spines, the porcupine fish swims about in comparative safety

By Myron Gordon
Zoological Laboratory, Cornell University

Not long ago an ingenious wolf hunter made the headlines by designing a hunting outfit that no beast would challenge. This hunter got a keg of nails and sewed the spikes into his hunting suit at close intervals. The iron spikes stood out on his homely coat of armor like the piercing quills on an alarmed razor-back hog. Someone called the inventor the porcupine man. The idea was good. No beast could touch the man-porcupine and go away unimpressed.

Long before man got the idea of a barbed-wire-like suit for defense, long before the porcupine itself developed its pelt of quills, the porcupine fish was swimming about in comparative safety, protected from its enemies by an elaborately constructed coat of sharp spines. The spines of a porcupine fish are reconstructed scales—scales that have grown to a point. The spines are "built in"; they are a part of the porcupine fish's external anatomy; they are warning signals to greedy sea marauders; they convey the idea of "*Verboten*." They are effective.

Spines for self defense

Spines for self defense are almost as well developed in the plant, as in the animal kingdom. The members of the cactus family have spiny coats of infinite variety. Even a palm tree has adopted the protective principle of the spine. The porcupine palm of Antigua faces a world of enemies with a whorl of long, sharp spines that winds around the trunk in an ascending spiral. The thorns have a habit of becoming detached when disturbed. Many an animal that has come too close to this vegetable fortress has gone away licking its smarting wounds.

Fishes, in general, are past masters in the use of spines. Have you ever gone fishing for bullhead catfish and taken them off the hook? You know how careful you must be to avoid the sharp spines that are located on their pectoral and dorsal fins. Many fishes add poison to the injury they inflict. Poison glands, situated at the base of the fins, shoot a toxic secretion into the wound opened up by the lashing action of the pectoral spines.

Scales developed into long darts

In the porcupine fishes (*Diodon*) the spine idea is carried to its furthest development. Practically all their scales have been developed into long darts, and in order to maintain their streamline form for swimming purposes, their spines are neatly folded close to the body and point backward. Only when the fish is alarmed does it erect its spines. The mammalian porcupine controls the erection of its spines by skin muscles. The porcupine fish swallows a lot of water and puffs itself up like a balloon. The spines stand erect and rigid. This defensive reaction is effective if anything tries to swallow it.

A fish humpty-dumpty

When a porcupine fish is picked up, it swallows air and becomes balloon-like just the same. On the palm of your hand an inflated *Diodon* looks like an angry infant that lies helpless on its back in its crib and shows its impotent rage by pumping its lips and pounding the air with its feeble appendages. Its eyes gape wide for want of eyelids to close them. Its bloated, spherical body makes it look like a fish humpty-dumpty. Its small, soft, and flabby fins fan the air feebly and ineffectually. Its two-toothed mouth is puckered up, and its lips and teeth move continuously as it tries to gulp more and more air to puff itself up more and more.

When returned to the water and released, the *Diodon* lies on the surface for a second, expels water and air explosively, deflating itself instantly, and swims away as fast as its ridiculously small fins and tail can take it.

Women in tropical lands have a method of inflating and drying the skins of porcupine fishes. When illuminated from within, these globular skins make grotesque lanterns. The spiny globes serve in times of festivity and in war. The South Sea island warriors cut holes in the bottoms of these inflated and dried fishy ornaments to suit the size of their individual heads. When going to battle, they use the spine-covered skins as protective helmets.

Poisonous puffers

Porcupine fishes have scored successfully not only with their equipment of lances, but also with other means of defense. They have the ability to secrete a toxic substance from glands in their skin. One of the porcupine fish's closely associated family relatives, *Tetraodon,* the *muki-muki* of the Hawaiians, is regarded by those natives as the most poisonous of all fishes. The South Sea islanders will not eat the flesh of this fish, but they do dip the tips of their arrows into the poison of its gall bladder.

The versatile Francis Day, who was both the Inspector General of the Fisheries in India and Burma, and a surgeon major in the army at Madras, has contributed a few pertinent facts on poisonous puffers that ought to be recorded in this account. Day's comments (1879) have a unique flavor.

> The *Tetraodons* are termed *Kuddul mah-cutchee* or sea frogs by the natives of Malabar, on account of the noise they make when captured. Although they are occasionally eaten by the lower classes, they are said to occasion indigestion, so are usually avoided, while all of them emit an odour the reverse of agreeable. The native doctors sometimes prescribe them in cases of lung affections. The Burmese in some districts consider these fishes to be poisonous, but in other localities they eat them, being careful first to remove the gall-bladder, which they assert occasions all the poison symptoms. The Andamanese eat these fishes, as I personally witnessed; they appeared rather to prefer them to some of the better kinds. At Cape of Good Hope the eating of spotted *Tetraodon* has caused so many deaths amongst the sailors in harbour, that they are specially warned against employing them as food. Due to their poisonous nature they are even objected to as manure in Malayan countries. The Japanese eat one species as a means of enabling them to commit suicide.

Porcupine fishes have a third defense. They have two extremely strong and sharp teeth. The porcupine fish's technical name, *Diodon,* means "two-toothed." (*Tetraodon,* their cousins, have four teeth, as their name implies.) Their mouths cannot open wide, but when their teeth surround something, that something is quickly separated into two parts.

You might think that even the most voracious predators of the sea would have sense enough to leave the porcupine fishes alone, with their spines, poisons, and savage teeth. But hunger is an urge so powerful on occasion, that a porcupine fish diet has been attempted. Through Darwin, according to H. M. Kyle, we get the story of an inflated porcupine fish that was found floating, alive, in the stomach of a shark. Did the *Diodon* poison its swallower? Darwin is credited with another *Diodon* story. A swallowed porcupine fish had eaten its way not only through the stomach of a shark, but the little barbed demon had also eaten its way through the shark's body wall and killed its selachian warden as it escaped.

Facing the enemy

Beebe (in *Beneath Tropic Seas*) says he saw a school of baby porcupine fishes milling about in close formation; all were puffed up, all their spines were rigidly erect. They were not puffed out because they were on parade. They were alarmed, for they saw a vicious gar eyeing them hungrily. The spiny puffers kept puffing; they kept close together; they held their spines erect like "the hollow square of a herd of musk-oxen with horns all pointed outward," facing their common enemy. Finally, one of the porcupine fishes darted out from the protected circle. The gar's "great jaws opened, snapped shut, and drew the unfortunate puffer down." The sad account stops here but, if the *Diodon* passed the gar's forest of teeth without injury, perhaps its life's story did not end with the snapping shut of the gar's jaws. Perhaps it was the beginning of the end of the gar.

A famous Egyptian species

All the porcupine fishes, *Diodon,* and most of their less spinous cousins, the puffers, *Tetraodon,* are marine, and are found in every tropic sea. A few, particularly the puffers of India, Ceylon, Malay, and Egypt, travel up the estuaries. Several species of *Tetraodon* actually pass beyond these tidal rivers and live in fresh-water streams. An Egyptian species, *Tetraodon fahaka,* lives in the fresh waters of the Nile. The *fahaka* is a famous fish and one that must have had some important symbolic virtue, for it appears commonly in the mural paintings of the ancient Egyptians. Unmistakable likenesses of it are found in the fishing scenes drawn on the walls of the pyramids of Giza and Saqqara. The eastern half of the south wall of Ptah Hotep's tomb at Saqqara is decorated with an elaborate battle scene being fought on water. The pictures represent a cross section of the battle. Above the water line the battle royal goes on furiously. Below the water line, below the keels of the war vessels, as if in sharp contrast to the warlike scene above, the artists painted a lovely scene of peaceful aquatic life. A partly inflated *fahaka* may be recognized easily among the many aquatic creatures that seemingly live contentedly in this lower, but gentler, world.

A four-toothed river beast

One fresh-water puffer of India has recently been brought to America by an enterprising aquarium fish dealer. The scientific name of the fish, *Tetraodon fluviatilis,* conveys the meaning that it is a four-toothed beast that has come from the river. It is a little fellow; the largest ones according to Francis Day, never get more than six and one half inches long in the natural state. Some of their marine relatives, like the porcupine fish, grow thirty inches long.

Aquarium pets

The fresh-water puffers are popular in the home aquarium. They eat all kinds of fish food but prefer raw meat; they are inclined to be scrappy; they are too small to do much damage with their strong teeth when handled; they will go obligingly through the typical swelling antics of their tribe when lifted from the water and tickled under the chin. Aquarium fish keepers are excited; they have discovered another parlor trick.

The porcupine fishes (the *Diodons*) are entirely marine, and live among the living coral heads. They have rich pickings. With their strong, sharp teeth they break down the hard calcareous hiding places of worms, shrimps, and other tiny inhabitants of a heavily tenanted coral community. If pickings should become slim in one community, all they have to do is to inflate themselves with air and, with belly upward, float with the Gulf Stream until they come to new hunting grounds.

A Whale Shark in the American Museum

The skin of a fifteen-foot specimen from Acapulco, Mexico. The world's seventy-seventh specimen

By E. W. Gudger

Bibliographer and Associate Curator, Department of Fishes, American Museum

For twenty-three years I have been pursuing whale sharks, *Rhineodon typus*—indeed, ever since in July, 1912, I saw hanging on a long pole under a shelter at Miami, Florida, the skin of the thirty-eight-foot specimen taken at Knight's Key in June of that year. This skin was the largest, the hugest, the most enormous thing of its kind that I have ever seen. From that day to this I have hunted the whale shark (by correspondence and in books) in the Atlantic, Pacific, and Indian oceans, and of the seventy-seven recorded specimens, I have put twenty-seven on the list.

The greater number of these specimens have been recorded from three restricted regions—in the Atlantic Ocean, seven fish from the Straits of Florida; in the western Pacific, fifteen from the Philippines; and in the eastern Pacific, twenty from the west coast of Mexico. Of these latter, three are recorded from the Gulf of California; eleven from Cape San Lucas; and six from Acapulco.

In 1933 Mr. Ralph L. Smith of Mexico City sent to the American Museum photographs and descriptions of some great sharks locally called *Tigres del Mar*, "tigers of the sea," captured at Acapulco, on the southern coast of Mexico, with a request for information. The requisite facts were communicated to him with a request for more photographs and data. Mr. Smith then sent photographs and accounts of five whale sharks captured at Acapulco—in 1932 (one) and 1933 (four). These were harpooned by Pancho (Francisco) Moreno, the chief fishing captain and guide of the port. From this extensive data, Smith and I prepared an article, "The Whale Shark at Acapulco, Mexico," which was published in the *Bulletin of the New York Zoölogical Society*. This was illustrated by splendid photographs of these sharks taken immediately after their capture.

In a footnote to the above article we made bare mention of the taking in these same waters of another (the seventy-seventh recorded) *Rhineodon* whose capture and whose skin are the *raison d'être* for this article. For an excellent photograph of this specimen and the following account of its capture, I am indebted to Mr. Charles T. Wilson of New York, a member of the American Museum, who headed the fishing party. Mr. Wilson writes:

The capture

On March 2, 1935, my friend, Angel Moreno, and I were out fishing in a speedy launch with Pancho and a crew of three (one being Pancho's son, who seems destined to follow his father's calling as harpooner of Rhineodons). When about five miles from the bay of Acapulco and about one thousand yards from shore (just off the Pie de la Cuesta, where the other whale sharks had been taken), Pancho sighted our quarry.

We immediately headed the boat about and within one minute Pancho had made a successful thrust of the harpoon and the excitement began. Several hundred feet of rope went out quickly, the launch was speeded up to go along with it, and at every opportunity to take in slack we pulled it in.

The strike was made about three o'clock in the afternoon, and about half-past six we succeeded in pulling the boat up to the giant shark. However, it turned to dive, and as its tail rose out of water, Pancho, who (from past experience) was ready for such a manœuvre, very deftly threw a rope lasso around the tail and made it fast. We then decided to bring the huge fish into port alive if possible, and all of us, crew and fishermen, slackening on the harpoon line, laid hold on the lasso, but we could not do a thing with our captive. It went its way and we went with it. All we could do was to let it drag the launch and, whenever possible, we took up slack.

Following these tactics, in about an hour we succeeded in somewhat tiring out the shark. Next the lasso around the tail was tied to the stern of the launch, and an attempt was made to tow our captive tail foremost. However, it turned on its back (as I understand sharks do under such circumstances) and its large front fins winged out and acted as brakes to our progress. It was like trying to tow a house.

Slackening up on the lasso fast to the tail, we got launch and fish close together again, and Pancho succeeded in securing the fish with a great hook in its mouth. Then slackening up on the other lines, we fastened the line from the hook to the stern post of the launch and towed the whale shark head foremost into the bay. It righted itself and came along without offering much resistance (perhaps it feebly swam with us), but we were all pretty well tired out when we reached shore about half-past nine at night.

Our captive was secured by the lines from harpoon and hook to stakes driven in the sand, and a watchman was left on guard. The next morning, since there was no derrick to lift our prize up for inspection and photography, we got it up on the beach by the use of planks and rollers, and several photographs were taken.

This great fish was not only photographed but, at Mr. Wilson's suggestion, Pancho skinned it and put the skin away in salt. Before leaving Acapulco, Mr. Wilson gave the skin of this whale shark to Pancho. Pancho later contracted to sell it to a Mexican gentleman who wished to acquire it for a museum in his city. However, this plan was not carried to completion—to our eventual gain. The subsequent history of this skin follows:

I heard from Mr. Smith in Mexico City on March 11 of the capture of this shark and the chance of getting its skin. He was empowered to act as agent of the American Museum and through his kindness the skin was purchased for us from Pancho. Next Mr. W. H. Hudson of Acapulco kindly saw to its preparation, packing, and shipping. Finally, early on the morning of April 22, I had a hurry call from the Ward Steamship Line—"We have on our wharf a powerfully smelly shark skin consigned to you. If you love us please get it away at once if not sooner."

This we did, and the skin is now in our department of preparation being tanned—the first stage in anticipation of mounting. Thus the American Museum eventually will have a fine mounted skin of this, the seventy-seventh recorded specimen of the whale shark, which is at once the largest fish and the most markedly colored shark that swims the seas.

When Mr. Wilson heard how it had come to the American Museum, he generously sent me a check covering the total cost of the skin delivered into our hands.

Scarcity of mounted skins

The department of fishes in the Museum has long wished for a skin of this particular species for mounting, and twice has failed by a narrow margin to get one. In June, 1919, a thirty-one-foot specimen was captured at Cape Sable, Florida, and its skin removed. An effort was made by a member of the Museum to purchase it for us, but the price asked was so exorbitant that the purchase was not consummated. Subsequently the skin went to pieces. Another whale shark was captured in June, 1923, at Marathon near Long Key, Florida. Mr. L. L. Mowbray (now director of the Bermuda Aquarium) was at Miami and took over the matter of obtaining the skin for the Museum. Of his tremendous efforts to tow the fish to Key West, where it could be hauled out on a ship's railway for skinning, and of his defeat by the unprecedentedly high temperature of the sea water, record has been made in NATURAL HISTORY for March-April, 1930.

Mounted skins of the whale shark are few and far between. In Europe there are three (two of them old and poor mounts): one in the British Museum in London; another is in the Muséum d'Histoire Naturelle, Paris; and a third in Stockholm. There are two in India—in the Madras, and Colombo (Ceylon) museums. There was formerly a mounted skin in the University of San Tomas in the Philippines, but it has gone to pieces. I have known of three skins mounted for commercial display, but they have all disappeared. In none of these mounts has the fish been adequately presented. An unmounted skin has been preserved since 1902 in the United States National Museum.

The Acapulco whale sharks have furnished two skins for museums. One of these (about seventeen feet long) was purchased and sent to Sweden. Here it was excellently prepared and is to be seen and studied in the Naturhistoriska Riksmuseum, Stockholm. Our fifteen-foot skin is the other and, when mounted, it will be the only specimen on display in the New World. As a guide in mounting this skin, we fortunately have the beautiful photograph of the fish itself, which is reproduced herein.

It must be noted again that twenty whale sharks have been recorded from the west coast of Mexico. Some of these were very large—estimated at fifty or more feet—but the captured ones were much smaller. One taken in the Gulf of California measured only twenty feet. I have photographs of all six taken at Acapulco. I do not have measurements for these, but judging by the heights of the bystanders, it is evident that the sharks are all relatively small—fifteen to eighteen feet long. From this data the interesting conclusion can be drawn that *Rhineodon typus* breeds on the west coast of Mexico. Whether this great fish lays eggs (as some few sharks do) or brings forth its young alive (as is true of most sharks) is not known.

Whale shark behavior

Only one scientific man has ever dissected a whale shark—Sir Andrew Smith, its discoverer, 107 years ago—and his account of his specimen captured at the Cape of Good Hope contains no reference to the reproductive organs. Presumably his fifteen-foot fish was immature. Some day, somewhere, some ichthyologist will be so fortunate as to be present at the capture of an adult female, and by dissection will establish the mode of breeding. He will be a lucky man, one long envied by his fellows. When this fortunate dissection is made, it is my judgment that the whale shark will be found to be viviparous—*i.e.*, a live-bearer. The young when born must be of good size, too large to be hatched from a shelled egg extruded into the water. The just-born young must be at least three to five feet long—perhaps as much as eight or ten. *Quien sabe!*

Little is known about the habits and behavior of the whale shark. It is a whale in size and in its manner of feeding. In size it *is* huge—it has been measured up to forty-five feet and estimated to reach sixty by scientific men whose word cannot be gainsaid. Like a whale, it feeds by swimming along at the surface with its huge mouth open. Into this go small fishes, crabs, jellyfishes, and other surface-swimming creatures, also floating algæ. These are sieved out by the gill-rakers as the great volume of water flows out through the long and wide gill-slits, and they are then passed down the throat—which in the specimen dissected would about take a baseball or a man's fist.

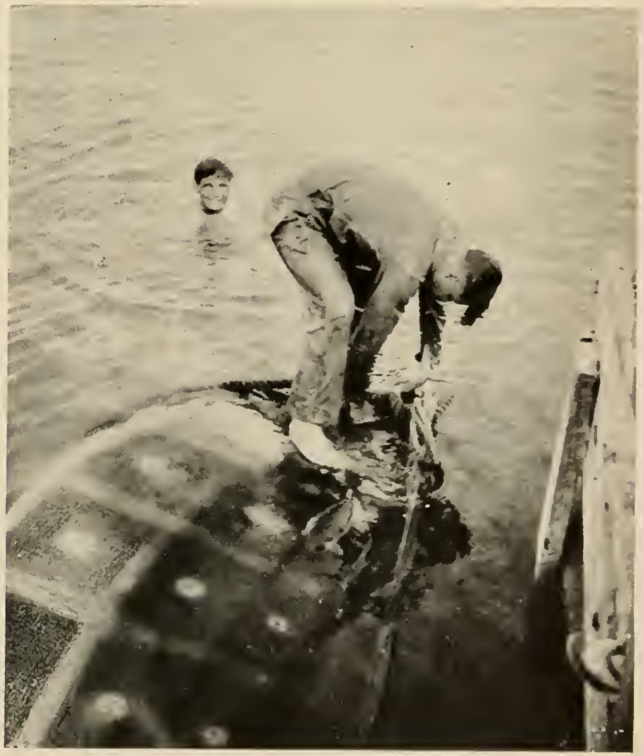
By the general public, sharks are deemed bloodthirsty creatures, and large ones are sure to be characterized as man-eaters. The whale shark is the largest shark but, far from attacking man, it is absolutely harmless. It might bump into a boat and do damage, and more likely might, in a flurry brought about by pain and fright, thresh out with its great tail (comparable in size to the "flukes" of a whale) and stave in a boat. Conceivably one of the largest size by a stroke of its huge tail might make kindling wood of a boat. Ordinarily, however, even when harpooned, it makes no particular fight, but by swimming at the surface or by diving merely seeks to get away. This was the behavior of each of the six specimens taken by Pancho at Acapulco.

The huge terminal mouth in an average-sized (thirty-foot) specimen would easily accommodate a small man, but the teeth of such a fish are only about one-eighth of an inch long. What they lack in size, however, they make up in number—about 3000 in each jaw. Some idea of the size and number may be had from the annexed picture of a fragment of a tooth band (natural size). These teeth recall those of the old-fashioned wool "cards" which I saw my mother use to card wool when I was a little boy. They also recall the teeth of a file; hence, the shark is named *Rhineodon* = *rhine*, a file; *odon*, tooth = file-toothed. Surely this great fish is correctly named.

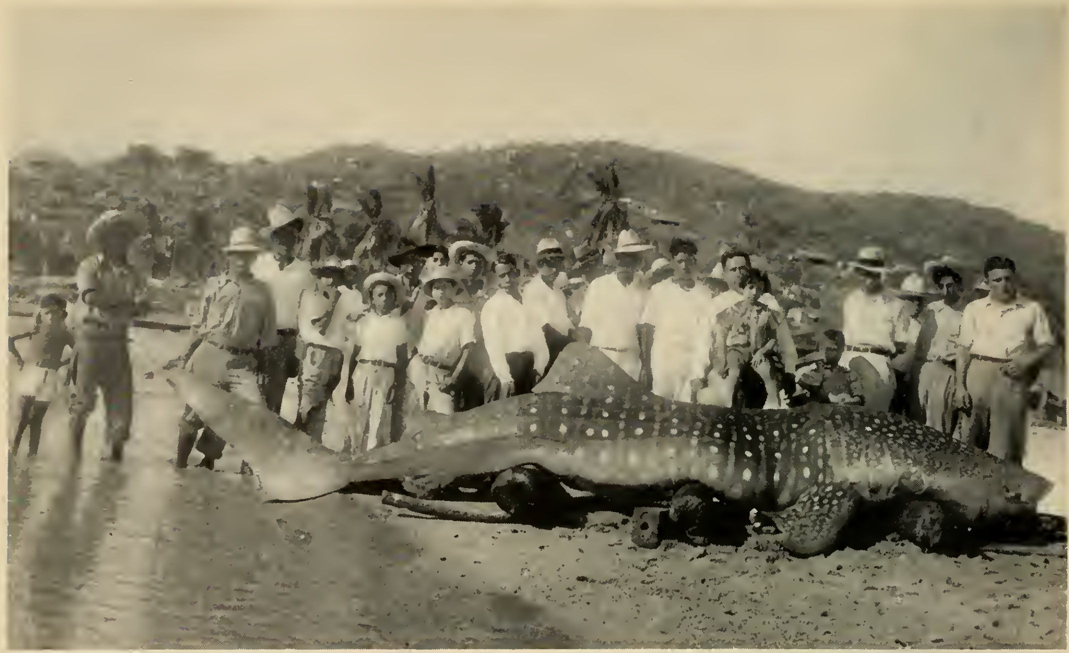
The whale shark has two trivial local names based on its unusual markings—the most extraordinary known on any shark. Two specimens have been recorded from off Havana, Cuba, and there it is called *pez dama*, "checkerboard fish." The photograph opposite explains this name. Along the dorsal ridge is a distinct keel, and three others run lengthwise on each side. These are crossed by vertical yellow or yellowish-white bars, and in the squares made by the intersection of keels and bars are found large yellow spots.

Again, the vertical bars and the large spots (also arranged in vertical rows) have led to the common appellation at Acapulco—*Tigre del Mar*. But, as has been shown above, our great fish is the mildest-mannered shark that swims the seas.

Pancho in action. He has the reputation of being the most skillful harpooner in Acapulco. Here he is shown at the most decisive moment in the chase. Photograph by courtesy of Dr. M. A. McIver



A bit of the side of the "pez dama" or "checkerboard fish." The pattern of squares and spots makes clear the reason for the name given to this whale shark in Cuban waters. The photograph is of a Florida specimen

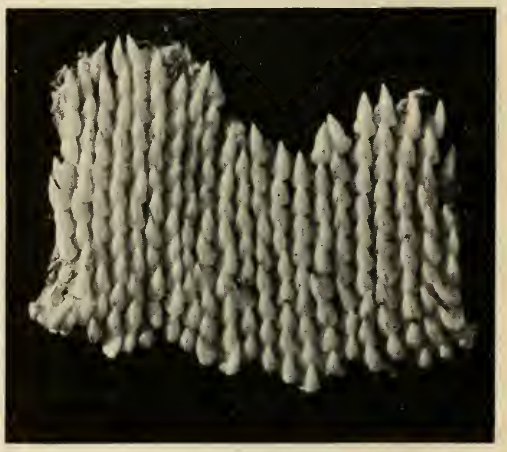


Photograph, courtesy of C. T. Wilson

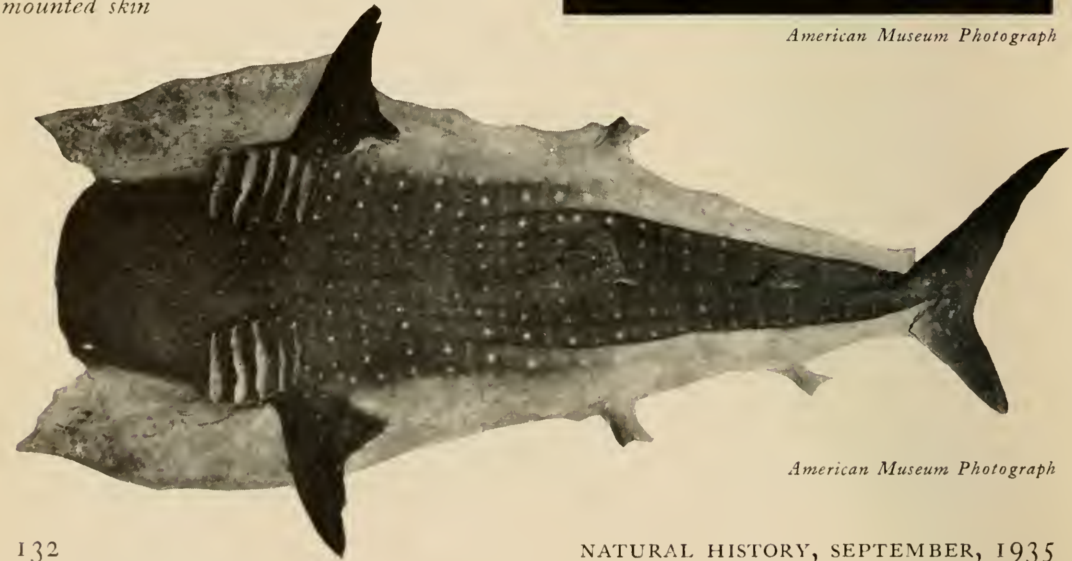
(Above) The "Tigre Del Mar" on the Beach at Acapulco. This shark was so large (fifteen feet long) that it was necessary to lay down heavy boards and drag the fish on rollers up on shore where it could be photographed and skinned

(Right) Teeth of the whale shark, slightly enlarged. This largest shark has the smallest teeth

(Below) The skin of the sixth Acapulco sea tiger. This photograph was made to show the exact location of the spots and bars, because these will largely disappear in the tanning process; now they can be reproduced accurately on the mounted skin



American Museum Photograph



American Museum Photograph

To the Strange "Buttons"

The story of the Bowdoin-MacMillan Arctic Expedition of 1934 to Cape Mugford, Labrador, and the Button Islands of the Northwest Territories

By Alfred O. Gross

Professor of Biology, Bowdoin College

In the swirling, ice-laden waters of Hudson Straits, beyond Cape Chidley at the extreme northern end of Labrador, lie the "Buttons." These isolated, rugged islands were discovered by Sir Thomas Button as early as 1614 when he passed through the straits on his way to the discovery of Southampton Island and the exploration of the western coast of Hudson Bay. In all the years since that time they have stood as a challenge to all who visited that region.

The excessive tides which rush in and out of the straits, the blinding fogs, prevalent storms, and often impenetrable pack ice have made landing there a hazardous procedure. Every boat that has gone through the straits has wisely given these islands a wide berth. Even the Canadian Government tactfully cautioned our expedition not to attempt to land for fear that we might meet with disaster.

Who but an inquisitive naturalist or adventurer would ever care to risk a landing on those bleak and forbidding shores? To either of these, however, the urge might well be strong to go there.

First there was a certain mystery concerning these islands. Sailors had reported that, when they were passing them, strange sounds emanated from deep recesses in the high cliffs. What could be the source of these sounds? Furthermore, many speculations had been ventured as to the life that existed on the islands. Eskimos claimed that in years past the polar bear and walrus bred there. Did these great arctic mammals still exist there? There were hosts of questions, moreover, concerning the abundant bird life, for which the islands are especially notable. Where, for instance, could be the nesting places of the fulmars, large gull-like birds, which abound in the straits between the Buttons and Cape Chidley?

It was to answer these questions and to open up other biological secrets surrounding the locality that the Bowdoin-MacMillan Expedition of 1934 made the islands one of its main objectives.

Personnel of the expedition

Commander Donald B. MacMillan, loyal Bowdoin alumnus and famous arctic explorer, said he could land a party on the islands; and his staunch schooner the "Bowdoin" was made ready for the expedition. Seven Bowdoin College students volunteered their services to assist in the biological work and in navigating the boat under his command.

Dr. David Potter, professor of botany at Clark University, and two of his students joined us with the purpose of making a collection of plants of the Labrador coast. From the casual records of previous expeditions it was expected that the high mountains of northern Labrador and especially those in the region of Cape Mugford would yield a wealth of important botanical material, including remnants of preglacial forms of plants.

With these objectives the "Bowdoin" sailed from Portland, Maine, on June 16, 1934, with a personnel of fifteen men, including three professional seamen, a first mate, an engineer and a cook.

In addition to the crew there was one distinguished passenger, Arcturus, a huge, snowy owl, which through the Massachusetts Audubon Society, sought passage to his home in the northland. Arcturus had been wounded by a hunter near Boston after his migratory flight to New England. He had been nursed to good health by the warden of the Audubon Society, but the warm days of June were taxing his constitution, and certainly Labrador would be more agreeable to him than New England during the hot summer months. This unusual request was granted not only because the Massachusetts Audubon Society desired it, but also because we all welcomed Arcturus as a mascot. He became an important member of the party and there was a feeling of regret when we left him on the shores of Anetalak Bay above Nain, Labrador.

The Gulf of Saint Lawrence

With favorable weather the "Bowdoin" made a fast run along the jagged Maine shore, thence across the Bay of Fundy and up the Nova Scotia coast to the Gut of Canso. At Port Hawkesbury we took on the final supply of oil for the Diesel engine and then struck northward into the Gulf of Saint Lawrence.

Little ice was seen in the Straits of Belle Isle, but the next day after setting our course northward toward Battle Harbour we met no less than fifty beautiful icebergs. Some of them were enormous in size, with cathedral-like spires reaching upward to heights of a hundred feet or more. Some of the flat-topped bergs were literally covered with kittiwakes, which found these floating, crystal masses convenient resting places in the midst of their fishing grounds.

On the outer runs we met with shearwaters. These interesting birds have reversed the usual procedure of migrating from the south to breed in a more northern latitude. They breed in the south Atlantic and spend their summer vacation, a time when the cares of raising a brood are cast aside, in Arctic America.

Battle Harbour, our first stop on the Newfoundland Labrador and the real beginning of our expedition, has figured prominently in many explorations to the North. Almost every boat stops there to send its last farewell from the powerful radio station. We recalled that it was just twenty-five years since Admiral Robert E. Peary had telegraphed the first news of his discovery of the North Pole.

Battle Harbour was formerly the site of an important hospital of the Grenfell Association, but today only the blackened stones and bricks of the foundations remain of the buildings, which were burned November 2, 1930.

That the hospital is sorely missed is evident to anyone who stops there. Soon after we anchored, two natives came aboard for medical attention. We also visited a boy suffering with a severe ulcerated tooth. He was the son of a fisherman who lived at the head of a cove about a mile from Battle Harbour. The family were living under the most wretched conditions. The house was constructed of rough boards, and pieces of tin and bits of sod were used to stop the raw wind and cold rain. Inside, a box served as a table, on which stood a dingy old lamp and a well-worn copy of the Bible. Two broken chairs and a dilapidated bureau constituted the only other furniture. The beds were merely grass-stuffed mattresses on the floor. A rusty, smoky stove kept the occupants warm and served for their simple cooking.

The parents expressed deep gratitude for the relief we had given their boy. Our trip over the rugged hills helped us to understand the enthusiasm the Grenfell workers have in serving the people of that desolate coast. It is a hard life that these people live, and it is a great satisfaction to anyone to be able to aid them.

At West Turnavik the expedition accomplished one of its objectives in banding several hundred arctic terns. It has long been known that these terns, which breed in large numbers on some of the low-lying islands, winter in the Antarctic Archipelago beyond the South Atlantic, but just what route they follow in making that long journey was not known until recently.

Arctic terns

In 1928 Dr. Oliver Austin, Jr., banded a number of terns with tabulated aluminum bands supplied by the United States Biological Survey. He received returns from Europe; and one of the banded birds was found in South Africa. These observations indicate that the migration is not by way of the Americas but across the Atlantic to Europe, southward along the coast of Africa to Cape of Good Hope, and thence to the Antarctic. The round trip between the Antarctic and these islands is a flight of approximately twenty thousand miles.

We hope that the large number of terns which our own expedition banded will establish in detail the migration route of this remarkable bird.

Our main objectives lay far to the north, and our party pushed on without delay. At Hopedale, where we were welcomed by Dr. W. W. Perrett, we would have enjoyed a stay of many days. Doctor Perrett is the Moravian missionary, to whom Mrs. Anne Lindbergh referred in her article in the *National Geographic*. The story we heard from him of the privations suffered by the inhabitants of this isolated village was most distressing.

Too much credit cannot be given the Moravian missionaries, whose splendid work has been the salvation of the people of the Labrador coast. They have protected the interests of the Eskimos against the white man, who too often in the past has taken advantage of them, and have improved their living conditions in general.

Hopedale is like an oasis in that barren coast, and it was with regret that we left it.

An unusual welcome

At Nain, as at Hopedale, our boat was the first to arrive that year, and we were received with an unusual welcome. Practically the whole village assembled on the warf, and in their native tongue sang songs of welcome. The sun had just dipped behind the mountains and a beautiful sunset glow added a bit of color to the touching scene.

As soon as the clang of the anchor had ceased, a fleet of small boats landed a swarm of happy Eskimos on board the "Bowdoin." There were loud greetings of "*Awk-sha-nai*" (Hello, or Welcome), and there was scarcely standing room on the limited deck space. Commander MacMillan stood at the door of his cabin and like a Santa Claus dealt out boxes of huge gum drops, candies, and presents. After fifteen expeditions to the land of the Eskimos, MacMillan well understands how to make the natives happy. No wonder the cheery "*Awk-sha-nais*" when "Captain Mac" came to pay them another visit. Near the Moravian mission is a school which MacMillan established and which he continues to maintain.

On Sunday the little chapel at Nain was filled to its capacity. Practically every native man, woman, and child in the community was there, for they consider it a great privilege, not merely a religious duty, to attend the services. All entered heartily into the singing, accompanied by the little organ. This part of the service was amplified by the howls and cries of several hundred Eskimo dogs, which constituted a real source of competition for the human voices. It was difficult to determine whether the response of the dogs was one of appreciation or annoyance.

At Nain, as well as at other villages, the members of the expedition bartered for sealskins and articles such as parkas and boots, to be used by themselves or to be taken back as gifts to their friends. Lawrence Flint, one of the Bowdoin students, discovered a fine thirty-foot, walrus-skin dog whip. It was just what he desired as an addition to his already extensive collection of whips. The Eskimo owner made it known that he wanted Flint's pants, and there being little time left before sailing, Flint removed his pants and exchanged them for the coveted prize. The return of the funny white man to the boat-landing was through a gauntlet of black eyes and a barrage of grinning faces.

The next day we were at Cape Mugford, with the great summits of the Bishop's Mitre, Brave Mountain, and other peaks of the Kaumajet range standing at majestic attention as our little ship sailed by. Dr. David Potter, the botanist of the expedition, and his two assistants were put ashore with their tents and equipment to begin their work in this important area, which was one of the major objectives of the expedition.

Labrador coast plants

Doctor Potter succeeded in collecting more than 20,000 plants along the Labrador coast, one of the most comprehensive collections ever taken from that region.

After landing his party, we pushed on toward the Button Islands. Good weather enabled us to arrive on July 11 at Grenfell Tickle, which cuts through the northern Tip of Labrador, connecting the Atlantic with Ungava Bay. We hoped by this passage to reach Port Burwell, or Killinek as it is known to the Eskimos, where we were required to report to the Canadian Mounted Police. It was necessary to present our explorer's permit, and to take on a Canadian representative, as required of all expeditions entering the Northwest Territories, of which the Button Islands are a part.

When more than halfway through the passage, however, we encountered the drift-ice pouring eastward, driven by a strong ebb tide. Loaded with hard, blue blocks of ice from the Polar Sea, it was a tide which the best ship in the world could not have stemmed. We retreated and sought a safe harbor at the entrance to the Tickle.

The next morning Commander MacMillan undertook to reach Port Burwell by rounding Cape Chidley to the north.

From Cape Chidley, we could see the dreaded Buttons, a mass of rugged islands with sheer cliffs hundreds of feet high. At last the main objective of the expedition was in sight, but we still had to touch at Port Burwell.

Soon after passing into Gray Straits we were confronted with great fields of pack ice and an opposing tide of eight knots, which again forced us to seek a harbor on the unexplored and uncharted coast. Easing along within a few yards of the big, black cliffs, the "Bowdoin" finally turned into the quiet waters of one of the best harbors in northern Labrador, a place which we hope to have named "Bowdoin Harbor."

The next day a "pea soup" fog, for which Cape Chidley is notorious, held us in the harbor. It was not until July 14 after several futile attempts that we succeeded in reaching Port Burwell.

Except for the factor of the Hudson's Bay Post and the two Canadian Mounted police, the population of Port Burwell, numbering about seventy-five persons, is entirely Eskimo.

Human parasitology

The Eskimos at Killinek are more primitive than those we found at Hopedale and Nain. In winter they live in snow igloos built wherever the best hunting and trapping are to be found, but during the more moderate weather of summer they congregate in villages along the coast, living in tents of their own construction.

The United States Bureau of Entomology had expressed the desire that we secure parasites of the Eskimos, a project which I assigned to Howard Vogel, Jr. At "Killinek" three natives were supplied with vials of preservative in which to collect the lice, known to them as *Koo-miks*. The next morning the vials, filled to capacity, were returned to us by the beaming natives, with the interesting information that "they had every *Koo-mik* in Killinek." If this statement were true, it was a good service to the community as well as an accomplishment in the interests of human parasitology.

When we attempted to leave Port Burwell for the final run to the Button Islands, the "Bowdoin" through the failure of the engines to function properly was thrust upon a rocky ledge near a cliff of the inner harbor. The thirty-foot tide was running out rapidly, and in less than an hour the "Bowdoin" was high and dry on the rocks. With the return of the tide, however, we were floated off with no harm done beyond the inconvenience of a six-hour delay. This experience well illustrated the wisdom of maneuvering about uncharted coasts and harbors only during the lower stages of the tide. To be cast on a rock at high tide would mean disaster.

On to the "Buttons"

Early on the morning of July 24, five weeks out of Portland, Maine, we were on the last leg of the journey to the Buttons. The weather was clear and calm and a comparatively small amount of ice remained in the straits. Our approach was so arranged as to arrive at the islands at dead low water, a time when the tidal currents are at a minimum.

We had with us an Eskimo from Port Burwell by the name of Ah-yah-o, who was familiarly known to the Post as Bobbie. Bobbie had once made a trip to the Buttons to hunt seal. He knew the islands, the channels, the possible camping places, and the water supply, better than any other human being. He had even served as guide for an aërial expedition which had photographed the islands two years before. His intimate knowledge of the Cape Chidley region had on one occasion been the means of saving the lives of an exploring party. We were most fortunate to have his services as guide. He could not speak English, but he was very intelligent and could understand and anticipate almost our every want.

Bobbie took the wheel of the "Bowdoin" and piloted us through the narrow eight-mile channel between Lawson and MacColl Islands to the head of a cove on the southern exposure of Lacy Island, which was to be our camping site and headquarters while on the Buttons.

While the islands are almost devoid of vegetation, the channels and especially the coves and bays leading to them were teeming with animal life. On every side the curious seals popped their heads out of the water in apparent bewilderment of the strange craft encroaching upon their domain. Thousands of birds arose or scuttled across our bow. The kittiwakes and fulmars were to be seen in every part of the islands, but we looked in vain for their nesting rookeries. Kittiwakes later were found nesting on the Knight Group of islands south of the Buttons. Frequently, as we rounded an island or point of land, we surprised a mother eider duck with her brood of downy young. Several honking red-breasted loons flew high overhead like so many airplanes out in honor of our arrival. It was still summer, yet countless numbers of red-breasted phalaropes and many other shore birds had already arrived at the Buttons on their way south from their breeding places beyond the Arctic circle.

This lively trip through the whirlpool channels was indeed an auspicious introduction to our ornithological conquest of the islands.

The "Bowdoin" lingered just long enough to put our party of six men, including Bobbie, ashore on Lacy Island. And her departure was none too soon, for an hour later the tide was running rampant and whirlpools of ice were swirling in the channel in front of our camp.

When we bade good-bye to the men on the "Bowdoin" no one could predict when they would return for us, as conditions in that region are most uncertain. Should the ship meet with disaster by storm or be crushed in the ice, we had planned to return to Killinek, the only human settlement in all that vast section, by means of a dory left with us for that purpose.

Bird collecting

Our tents were pitched on a small area of high level ground near a brook of pure water fed by the melting snow on the hills beyond. Fortunately for our comfort the wind-swept islands were free of mosquitoes and black flies, which ordinarily make life in the far north an intolerable existence.

There are no trees, not even tiny shrubs, that could be used as fuel; hence we had to depend on two Primus oil stoves for our cooking. Later, however, we found pieces of driftwood, probably from Ungava or Hudson Bay, which had been carried by the tides and thrown high on the rocks by the storms. Every bit of this wood we could find was collected and used as fuel during the chill days that followed.

Lanterns and flash lights were not needed in that northern latitude, since the sun stays above the horizon except for a short time each day, and when it sets, a bright glow remains in the sky. We were therefore able to carry on our work at any time during the twenty-four hours. I asked Bobbie how he knew without any timepiece when it was time to eat or sleep. He explained that he ate when he was hungry and went to bed when he was tired. We also found it best to follow this simple and sensible routine.

Ponds and pools teem with life

The first evening a beautiful arctic fox came to within fifty yards of our camp. Evidently its curiosity had been aroused by the sight of our tents, which were certainly new to its experience, and it had come from its hillside lair to investigate. The moment we stirred, however, the fox wheeled about and galloped over the snow on the hillside until it reached a barren, rocky ledge far above us. At this safe vantage point it paused, rested on its haunches, and gazed at us intently. We were as interested in the fox as it was in us. It was delightful to know we were all fellow-creatures, a part of the biology of the islands.

We found no lemming or other rodents, the usual food of the foxes, but the many masses of feathers along the shore and among the rocks of the hills gave evidence that the fox and his fellows fared well on this their island kingdom. Everywhere we could see signs of this kind, which tell a grim story of the struggle for existence in the Arctic.

On high, inaccessible cliffs of Lawson Island we found the breeding places of the glaucous gulls, large pure-white birds which nest only in the far north. The fulmars were also present in great numbers in the channels and inlets about the islands, but if these birds nest in that region, their breeding places are yet to be found.

Mr. Robert Wait, assistant in zoölogy, busied himself in the collecting of invertebrates, and made many interesting discoveries concerning the occurrence and distribution of these organisms. He found the little ponds and tidal pools teeming with life. There is great opportunity for further work in this neglected field of Arctic biology.

On the second day, the party on the Buttons nearly met with disaster. A Primus stove exploded, spurting burning oil on the canvas of the supply and cook tent, which immediately burst into flames. The level-headedness and quick action of two of the men in pulling the burning tent away from the camp site prevented the destruction of our entire equipment housed in this and four other tents.

Seal steaks and polar bears

Bobbie killed five seals, three of which he succeeded in bringing to camp. The seal steaks broiled on a driftwood fire were excellent, and the livers proved a rare delicacy. Even if the "Bowdoin" were to be long delayed in coming for us, we were assured that we would be well supplied with food. Bobbie, armed with his rifle and spear, often sat for hours on the rocks in front of our camp, a picture of patience as he awaited his chance to kill. All Eskimos seem to have a lust for killing; they have no conception of conservation. To them every bird, every seal, exists merely for them to kill. They have neither feeling nor mercy for their victims.

On a grass-covered area at the western end of Lacy Island were tracks, droppings, skulls, and other evidence of polar bear. The Buttons, therefore, as the Eskimo had reported, are a rendezvous for this great white king of the north. We were not so fortunate, or unfortunate, as to meet with one of these beasts during our survey of the islands.

In this same section of the island we discovered ruins of ancient Eskimo igloos. Nearby were heaps of large bowlders which proved to be the graves of the people who had been laid to rest near their homes. In some of the graves time and the elements had bared the skeletons, and alongside the remains were deposits of spears and bone weapons used by these primitive people in their hunt for the walrus and polar bear. Similar graves and igloos were discovered on MacColl Island.

Near one of the Eskimo graves, well protected by an overhanging stone, was a nest containing five young of the American pipit. This delicate little warbler-like bird, whose nest we frequently discovered elsewhere among the rocks and in the tundra, winters in the United States, but migrates to the far north to build its nest and to rear its young. The pipit is eminently successful, for it is the most abundant species of land birds found in this region.

The ancestors of the pipits were the associates of the Eskimos who once lived there. One can readily picture an alert little native boy watching one of these birds and perhaps matching his skill against it in his first lessons in hunting.

The snow bunting, a striking white and black bird of the sparrow family, nests in the cracks of the cliffs. Some of the nests were placed so deep as to defy all attempts to extricate them. Several which we were able to examine were made on a well-defined pattern, with a thick foundation of soggy moss and a cup of fine grasses beautifully lined with the pure-white breast feathers of the ptarmigan. I can think of no bird that better typifies the land of ice and snow than does this hardy little bunting.

A too-brief sojourn

Our sojourn on the islands seemed all too brief, for they are rich in biological interest.

But what about those queer noises that were reported by the sailors aboard ships passing the Buttons? We came to the conclusion that they were either a product of the imagination or else are produced by the terrific tides rushing between the rocks, or by the ocean swell pounding in the cavernous thunder holes which occur along the cliffs exposed to the sea. Sounds of this sort are quite pronounced during certain conditions of the tides and winds, and perhaps are enough to kindle the curiosity and speculation of any person possessed with a vivid imagination.

In the midst of our interesting work we heard a siren whistle echoing and re-echoing from cliff to cliff. It was the "Bowdoin" back from Cape Mugford with Doctor Potter and his assistants. We were glad to know of their safe return, but it meant the end of our reconnaissance of the Buttons.

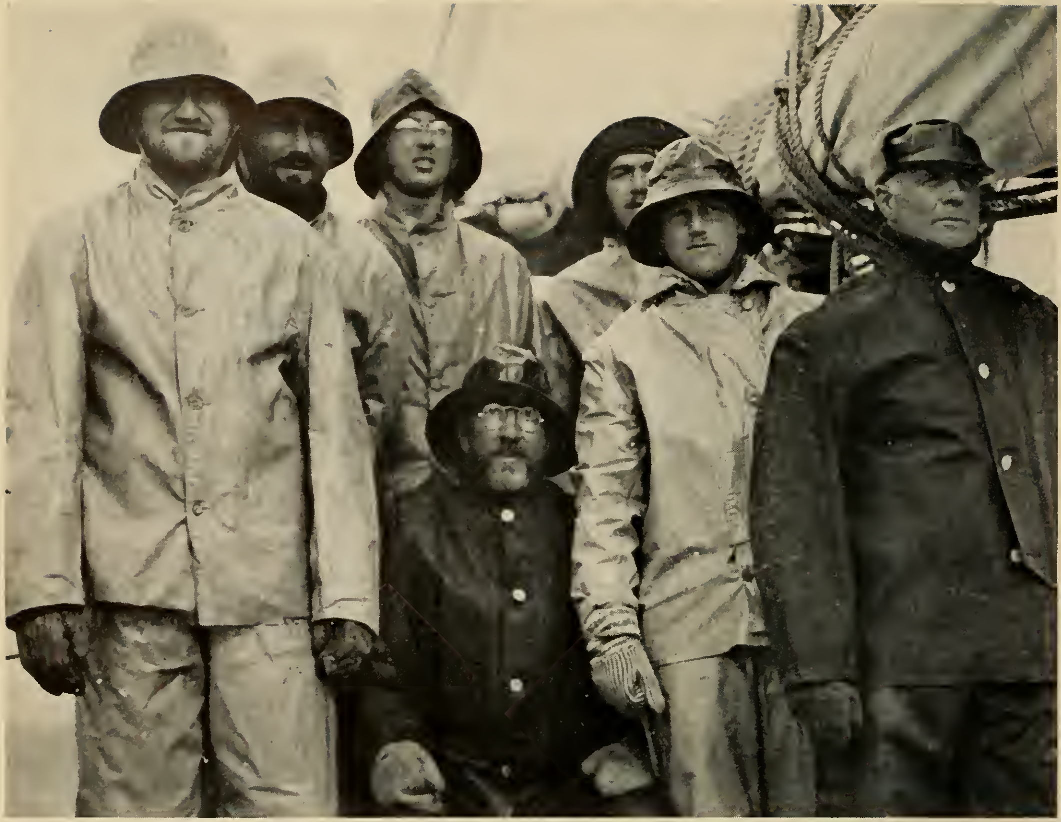
(Right) Silhouette of the "Bowdoin" cruising off the Gannet Islands, Labrador, during the Bowdoin-MacMillan Expedition of 1934. Photograph by W. R. Esson

(Right) Eskimos came in their sealskin kyaks to inspect the "Bowdoin" anchored in the harbor at Port Burwell, or Killinek, as it is known to them

(Above) Clark Harbor, so named by the Expedition, is well protected by the high mountains and many islands. Aërial photographs were a great aid in exploring hitherto unknown regions in the search for plants and birds

(Upper Right) Cape Chidley, the "Cape Horn" of the North, on a quiet, clear day. Ice, fog, tides, and storms frequently combine to make this region a terror to navigation

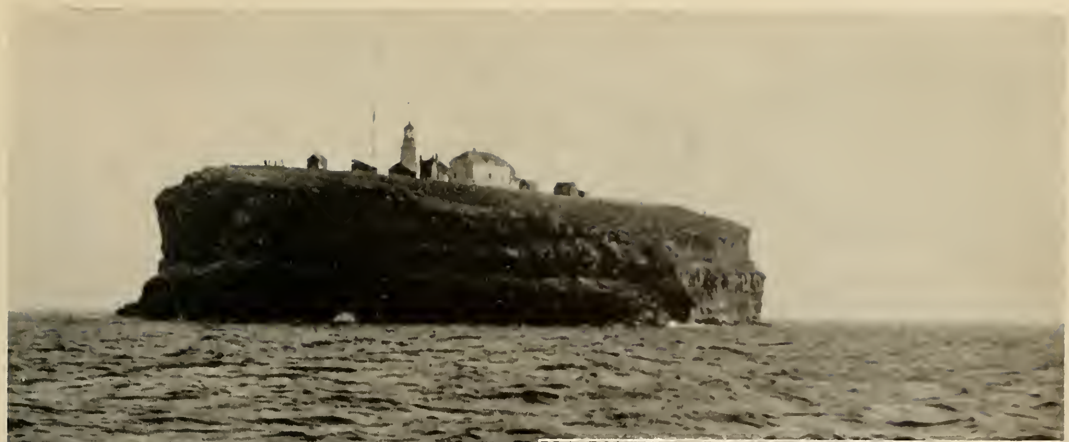
(Right) A crystal mountain from the Arctic. Hundreds of these silent sentinels guarded the coast of Labrador. Photograph by W. R. Esson



(Above) Left to right: W. B. Brierly, Robert Brooks Wait, Jr., Dr. Alfred Gross (seated), George H. Crosby, H. H. Vogel, Jr., and Commander MacMillan

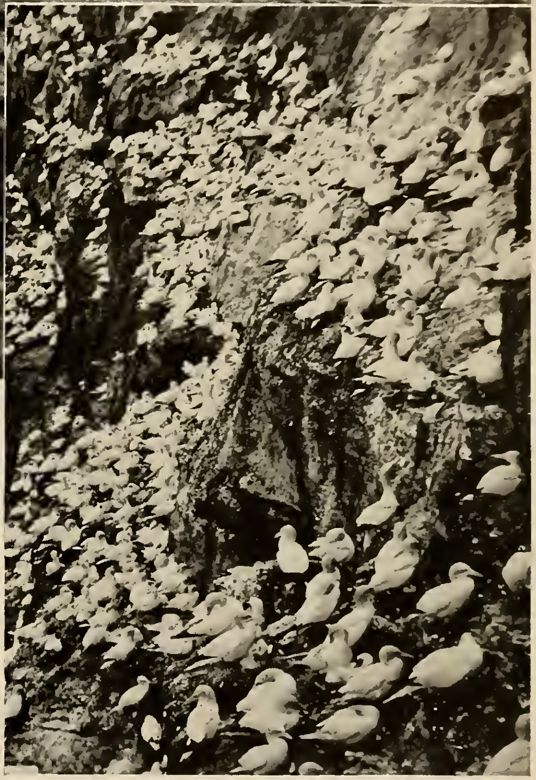
(Left) "Arcturus," mascot of the expedition, was a passenger on the "Bowdoin" from Boston to Labrador

(Below) "Bobbie," who served as guide for the expedition, cooking seal chops on a heated stone

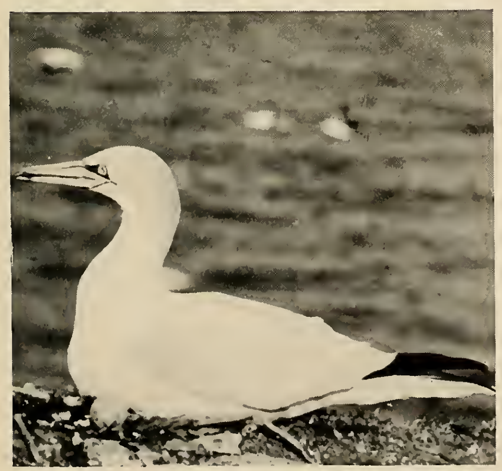


(*Above*) *Bird Rock, the sentinel outpost of the Magdalenes. Photograph by W. R. Esson*

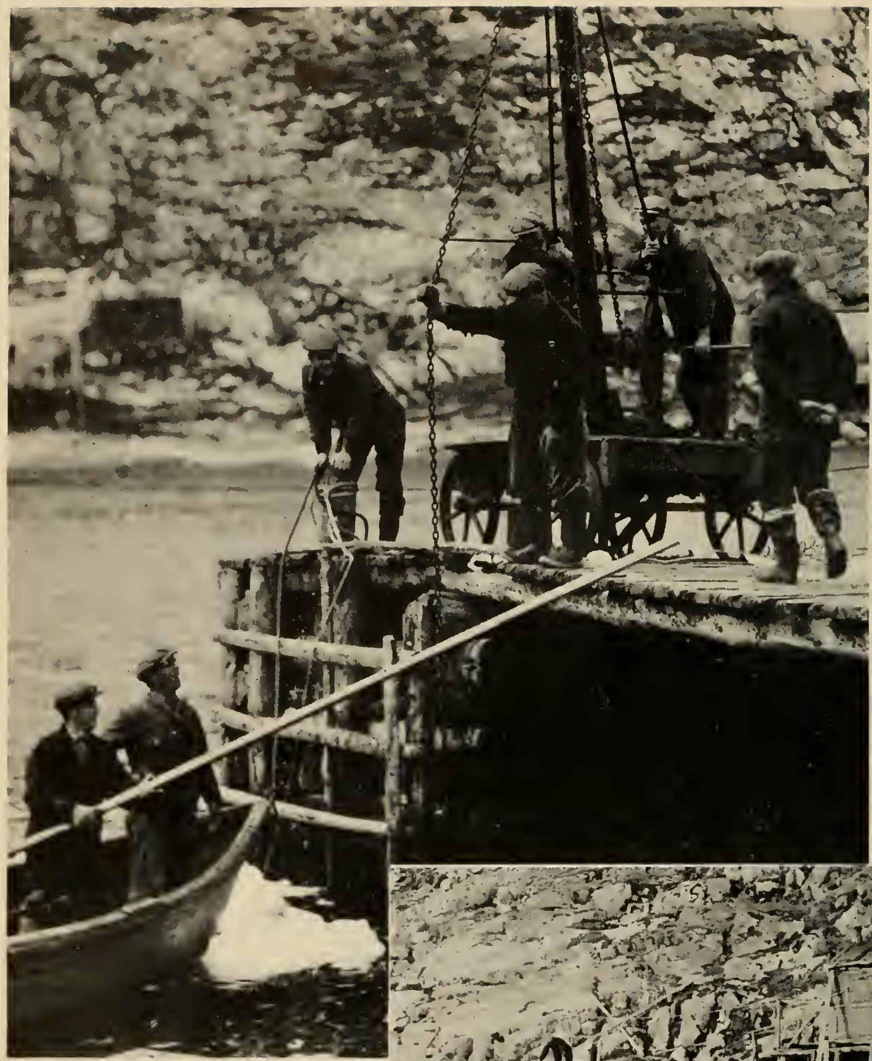
Bird Rock



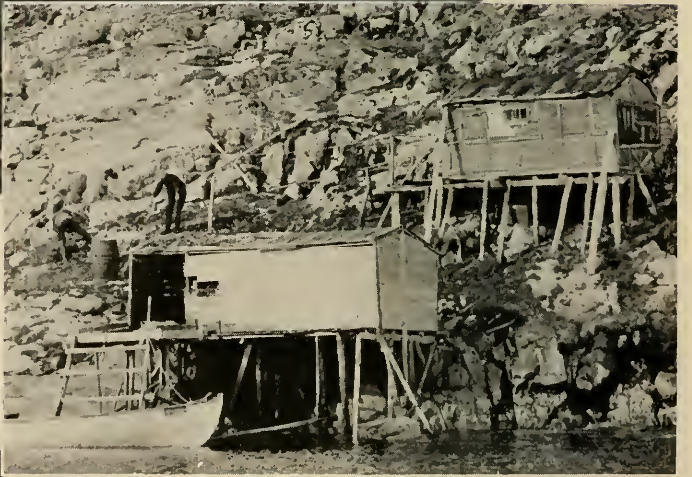
(*Above*) *A bit of the vast gannet rookery. It is marvelous that the eggs and young do not roll off the narrow, slanting shelves, to be crushed on the rocks below*



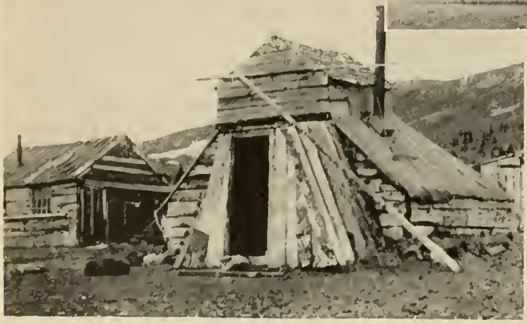
(*Left*) *One of the thousands of beautiful gannets nesting on Bird Rock. The single egg can be seen at the bird's left*



(Above) All the salmon are chilled and packed in ice from icebergs which are grounded on the reefs and shoals about this fishing village



(Above) A fisherman's home and drying shed at Battle Harbour. Most of the fisherman's income goes toward maintaining a fishing boat and gear



(Left) An Eskimo home at Nain, Labrador. The natives living near the missions use wood in the construction of their houses

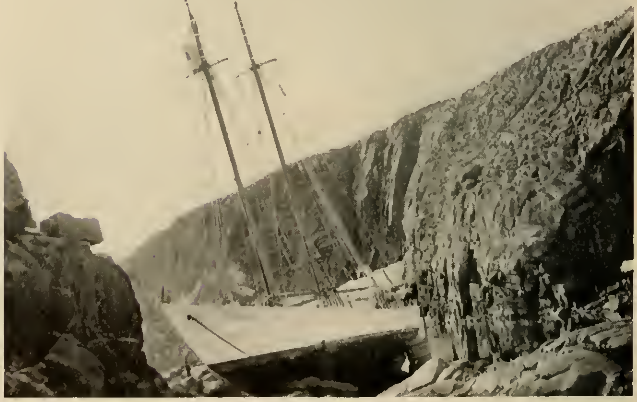
(*Above*) *A fine example of the pure-blooded Eskimos at Killinek. He is a brave hunter and a good provider for his family*

(*Above*) *Eskimo babies cry just like any other babies*

(*Right*) *Sometimes a husky's curiosity gets him into trouble*

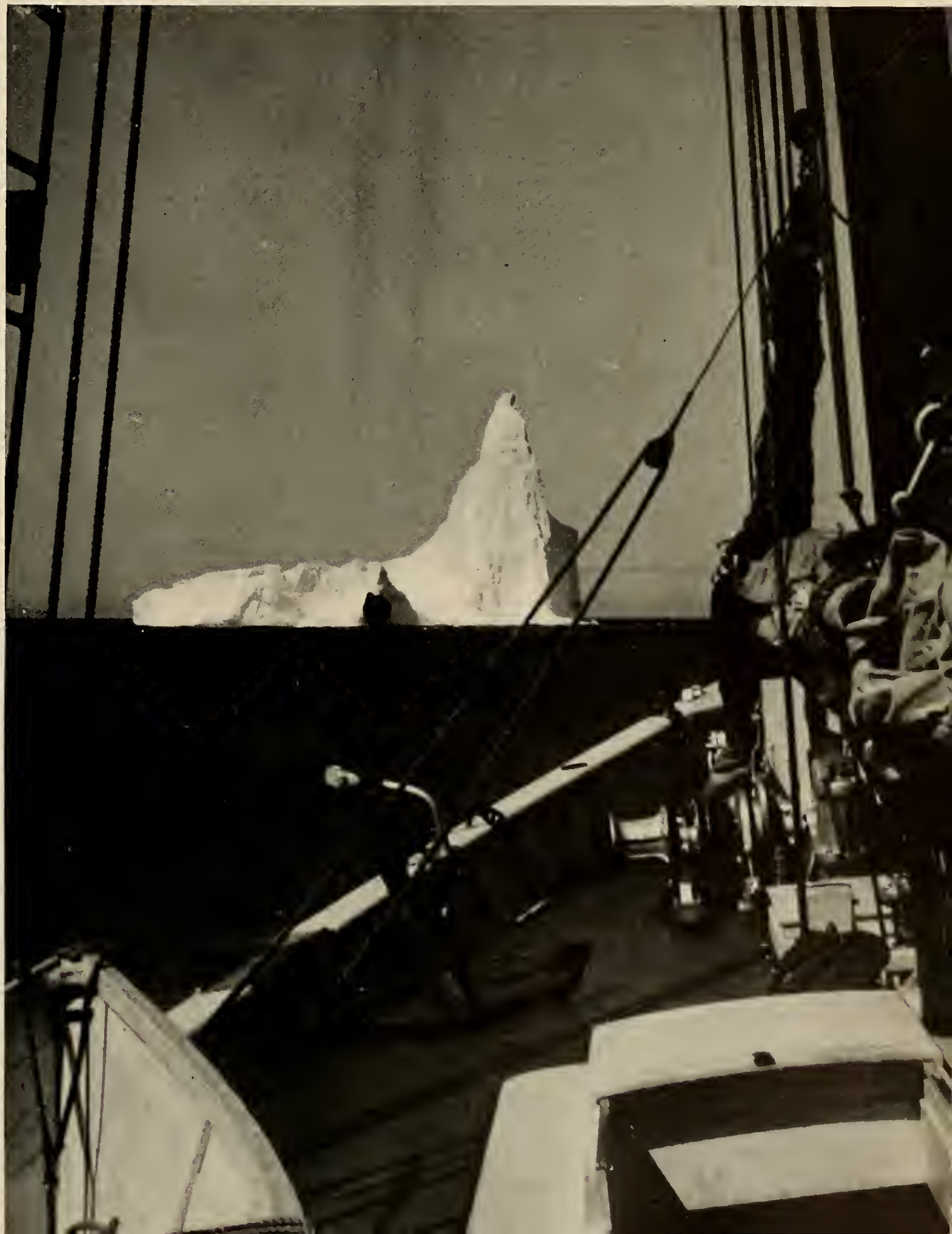
(Above) When the fog thickens and the ice packs and crushes in the rushing tides, it is time to seek a harbor for protection

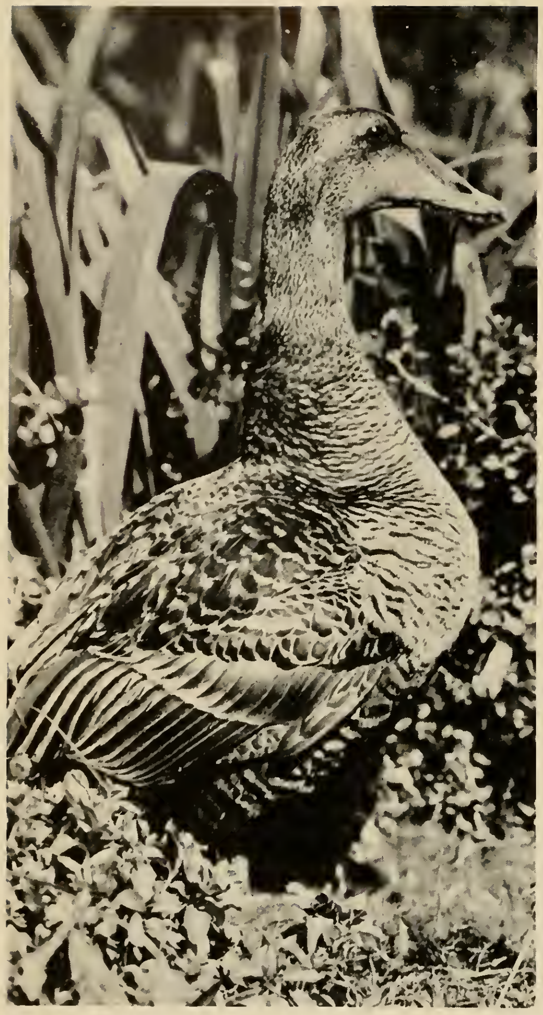
(Right) The "Bowdoin" on the rocks. When the engine failed to reverse at Port Burwell, the boat was thrust on the rocks, where it remained until lifted off by the incoming tide. Photograph by S. B. Gray

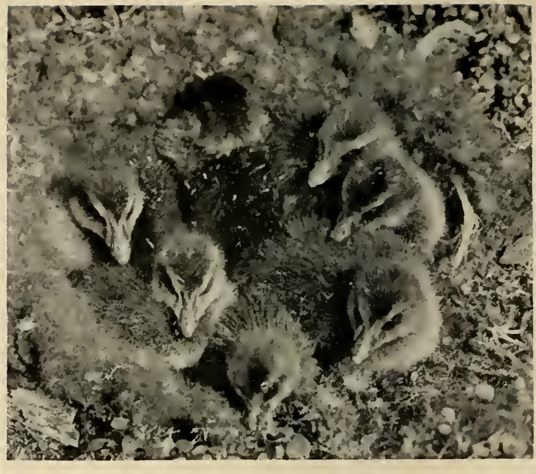


(Left) Here the "Bowdoin" is held fast by an ice pan which blocked the harbor at Port Burwell. The next day with a shift of wind and tide the ice pan left as mysteriously as it came. Photograph by S. B. Gray

(Below) A cathedral-like giant towers off the "Bowdoin's" port bow. The tip of the spire was more than 200 feet above the surface of the water. Photograph by W. R. Esson





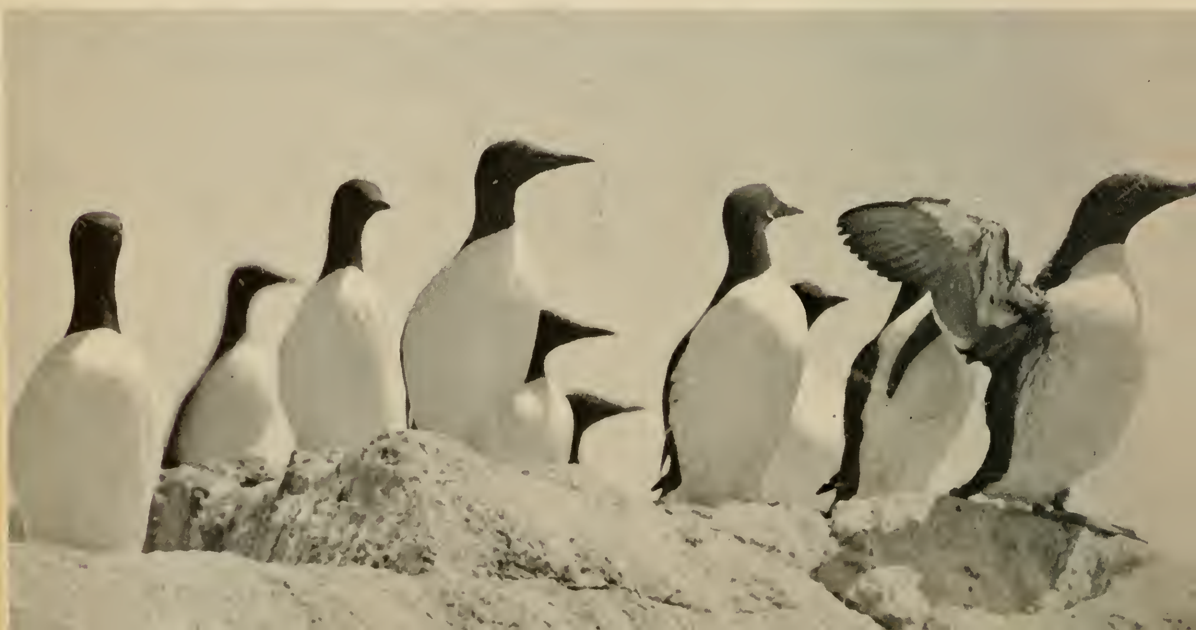


(Above) These young eiders are only a few hours old, yet they are ready to go as soon as the mother bird utters the command

(Left) This stately female eider is very solicitous for the safety of her young buried deep in the thick down of the nest

FAMILY

(Below) The plumage of these murres is immaculate after a long immersion in the water—a striking contrast to the filthy conditions that exist around their nesting places

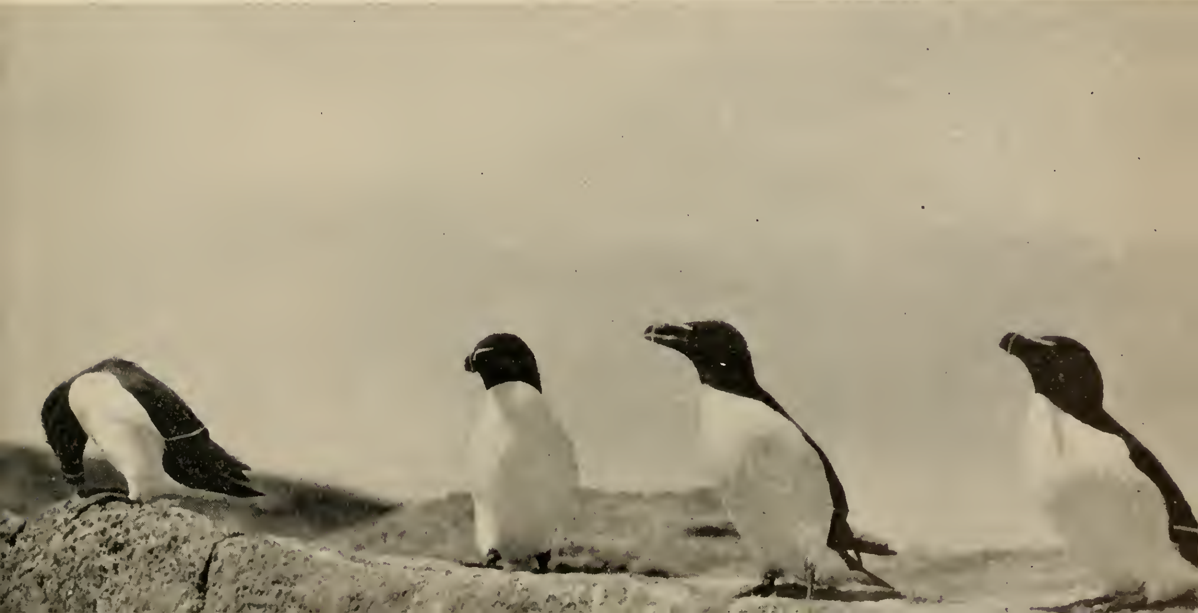


(Above) These downy young herring gulls, after toddling through wet grass, climbed on to a fallen tree trunk to dry themselves in the warm sun

(Right) The mother gull, alarmed by the noise of the camera shutter inside the blind, sounds a sharp note of caution

GROUPS

(Below) The legs of razor-billed auks, as in the case of many sea birds, are placed in an extreme posterior position awkward for locomotion on land



The puffin is the "sea parrot" of Labrador, but to the Eskimos it is "siggoluktok"—ugly-billed one

(Above) Black fishermen. Comorants nest in large colonies on some of the highest cliffs of rocky islands of the Gulf of Saint Lawrence

The snow bunting's nest is lined with the white breast feathers of the ptarmigan

Konrad Gesner Was Right

A profile of "The Father of Modern Zoölogy," who made many discoveries of present-day importance though he lived when scientists classed the hippopotamus as a fish and believed that the unicorn walked the earth

By WILLY LEY

[*Readers of* NATURAL HISTORY *Magazine may be interested to know that a more comprehensive account of this pioneer natural historian has been presented by the author of this article in a book entitled, "Konrad Gesner, Leben and Werk."*]

THE family of sciences that today is termed "natural history" came into being about 400 years ago, or rather, was then recreated and given new life.

This period—the last half of the fifteenth and the first half of the sixteenth centuries—was one of the most important the world has ever seen. It was dawn after the Dark Ages, new activity after the long sleep of mankind that had followed the breakdown of classical civilization. After being guided and governed by religion during that quiescent era, mankind rose, not to reject religion as a guide, but to deny it as a government.

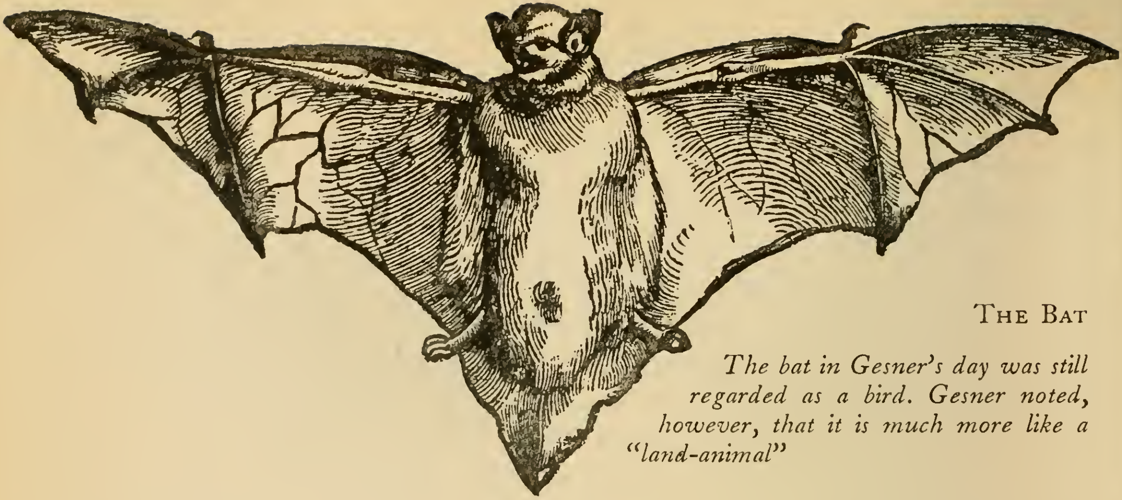
Towards intellectual progress Dante, Petrarca and Boccaccio had started what was later called the Renaissance; shortly afterwards Erasmus of Rotterdam became the first humanist. In Germany, the greatest of all Reformers, Dr. Martinus Luther, had, in 1520, burned the papal decrees and thus set in motion forces which were to enable scientific minds to investigate and to work unhindered by the Church. Physically the size of the earth had been doubled by Columbus, by Vasco da Gama who had circumnavigated Africa and explored the Indian Ocean, by Balboa who in 1513 discovered the Pacific Ocean, and by Cortez and Pizarro who conquered Mexico and Peru.

In those troublous times, when discoveries of all kinds were being reported by the dozen from all corners of the world by means of the newly invented printing press, scientists, mostly living rather poorly in their picturesque old towns, struggled to create natural history anew. The works of the great naturalists of Greece and Rome had been preserved (but also distorted) by the Arabs; and the Arabs themselves had added a few discoveries of somewhat doubtful value and truth. The task of the men of science was now to sift this material, to restore the ancient authors and to collect the new discoveries that poured in from everywhere. A clear survey of the wealth of nature, based on this new and rediscovered knowledge, was their goal.

This task was so difficult that every one who succeeded in contributing to the restoration of natural sciences deserves to be termed a great man. But greatest of them all, an outstanding figure even among these illustrious pioneers, was undoubtedly Konrad Gesner von Zürich.

He was a German-Swiss, born on March 26, 1516, in the city of Zürich in Switzerland. His father, a poor furrier, was a fanatic follower of Zwingli, the Swiss Reformer. Both Zwingli and his follower Urs Gesner, the father of Konrad, died in 1531 in the battle of Kappel, when Konrad was just fifteen years of age.

The youth was severely handicapped by poverty and ill health not only at this period but throughout his life, yet he persevered in professional and private study until he became one of the greatest natural historians.



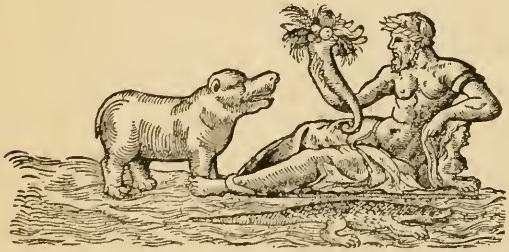
THE BAT

The bat in Gesner's day was still regarded as a bird. Gesner noted, however, that it is much more like a "land-animal"

For a short time he lectured as professor of the Greek language and literature at Lausanne. In March, 1541, he returned to his native city of Zürich as a *Doctor Medicinae,* having successfully disputed with his teachers the question whether the brain or heart is the source and control of the senses and motion. (*"An cerebrum sit, principium sensus et motus, an cor?"*)

In Zürich he established himself as physician and continued his studies. In 1554 the magistrates of the city appointed him city physician and public professor of natural sciences and philosophy. Ten years later the Emperor Ferdinand V granted armorial bearings to him and his family, and a coin showing Gesner's portrait on one side and his bearings on the other was stamped. This coin is the only contemporary portrait of him that is known.

In the same year the plague swept Switzerland, and the inhabitants of Zürich were stricken in large numbers. Gesner fought the epidemic successfully; but it broke out again the following year, and the city physician himself was this time among the victims. Gesner's friends persisted in the hope that he would be able to cure himself; but from the very onset of his illness Gesner himself was convinced that, with his stamina greatly reduced by overwork, he could not survive. He further seems to have placed a fatalistic belief in a dream he had had some time before. He dreamed that a poisonous snake had bitten him and took it as an omen that once an illness caught him he would never recover.



FATHER NILE

Father Nile and his typical animals, the hippopotamus and the crocodile

His last days were governed by the determination to put his rather cryptic botanical notes so far as possible into form for publication. During this time he worked incessantly in the little museum he had created. It was the first museum of natural history in Switzerland, and formed part of his house.

Gesner's last night is described in his first biography, written by his friend Josias Simmler.

"Now it was the fifth day of his illness and the *doctores* present had not yet given up hope and it really seemed as if he felt a little better. Therefore, when his friends asked him whether they should stay with him over night, he replied that they should not inconvenience themselves, and after having said his prayers went to bed."

That same night, feeling death was near, Gesner asked to be taken into his museum where he had spent the greater part of his life. There he passed quietly away a few minutes before midnight, December 13, 1565, at the age of only 49 years and 9 months.

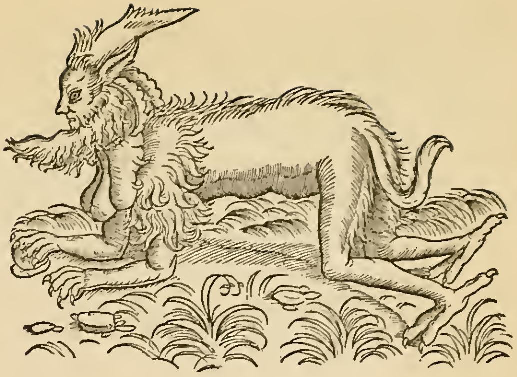
Gesner had completed only two of the four series of books he had planned. The first series, in 1545, was the famous *Bibliotheca universalis,* which was the first bibliography ever printed. It contained all the books in Latin, Greek, and Hebrew printed up to that time. Further, it included almost all classical Greek and Latin works that were still unprinted.

The second series of Gesner's great plan was the *Historia Animalium,* four heavy tomes, comprising more than 4500 pages in folio, illustrated by approximately a thousand wood-cuts. This likewise appeared volume by volume.

Gesner was known as the "German Pliny" and, later, the "Father of Modern Zöology," though he left his greatest work still unfinished. This work, one of the first encyclopedias of plants and plant life, met with a rather adventurous fate.

When Gesner was near death he asked the other physician of Zürich, Dr. Caspar Wolf, to promise to continue and finish this great work and have it published. Wolf, though fearing that he might not have the necessary knowledge, promised. When he examined the first chapters (about 100 pages in print), the 1500 wood-cuts, and the copious notes, he found the task even more difficult than he had imagined. He managed to finish the first eighty chapters, but then gave up, and with the consent of Gesner's heirs sold all the material to Joachim Camerarius in Nuremberg.

Camerarius also tried to finish the work but met with difficulties he could not master. He used the most beautiful of the wood-cuts to illustrate a few of his own botanical works but in general he did not touch the wealth of Gesner's collections. Many years later, in 1744, the head physician of Nuremberg, Dr. Christoph Jacob Trew, purchased them and turned them over to Dr. Casimir Christoph Schmiedel who spent several years in editing the botanical studies of Gesner. They finally were published in Nuremberg in 1753 and 1759 under the title *Opera Botanica Conradi Gesneri* in two big folio volumes.

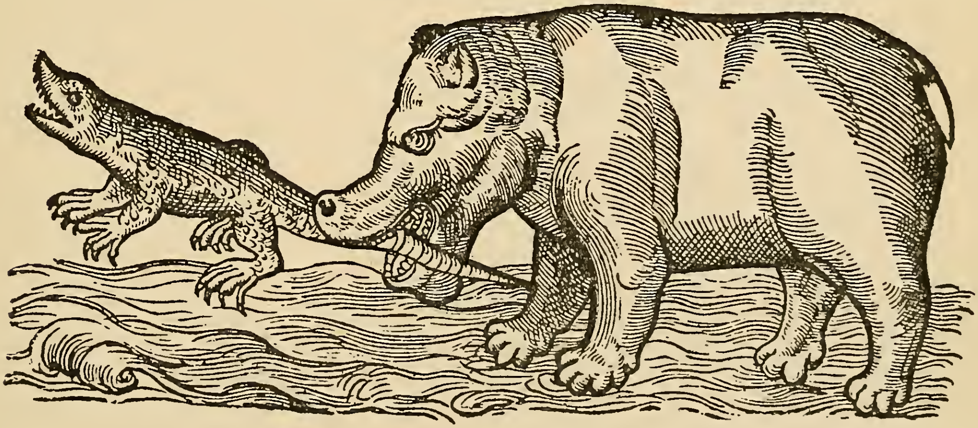


FOREST-DEVIL

The "forest-devil" as conceived by Gesner's artist. The reports regarding this creature probably refer to a roaming maniac

This publication proved that Gesner had been greater as a botanist than as a zoölogist, though he is chiefly remembered as the Father of Zoölogy. In his zoölogical books he pub-

---

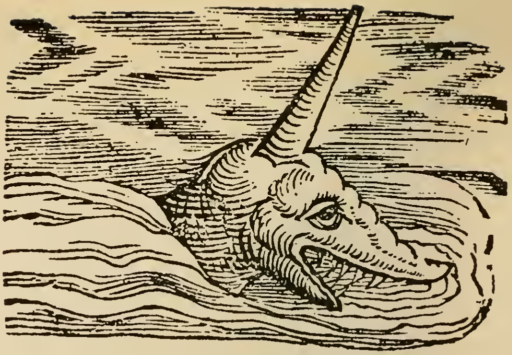


THE HIPPOPOTAMUS

One of the earliest illustrations of the hippopotamus. Its habits being unknown to the zoölogists of Gesner's time, the artist imagined that it ate crocodiles lished everything that was known about animals up to the time of publication. The books are essentially a careful and exhaustive collection of facts. The volumes deal with land animals, birds, water animals, and "snakes" (reptiles in general), in the order mentioned. But within each volume the order is merely alphabetical. Here Gesner failed to arrive at any scientific system. But in the field of botany he did devise a system, and this was centuries before the Swedish scientist Karl von Linné published his epoch-making volumes about systematics.

Gesner's principle was the same as that worked out, probably independently, by Linné. It consisted in the division of plants into a number of orders, each order comprising its families, species and subspecies. Blossoms, their petals and stamens were recognized as the principal means of judging relations. It is tragic that Gesner should have died before he could publish this great discovery. Without the parts of his plant book which were edited and published by Schmiedel we should hardly know that he made it.

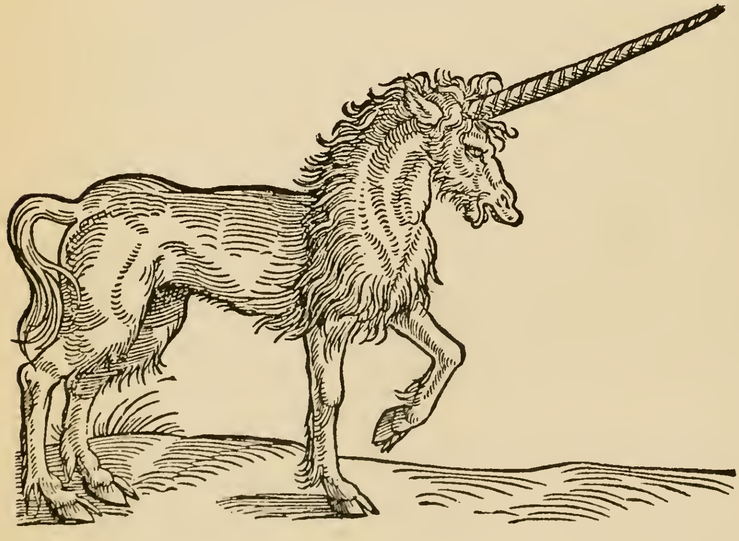
Though Gesner failed to make a comparable discovery in zoölogy, he is still rightly termed the greatest zoölogist of his time. Some passages in his books indicate that he was aware of relationships that were not known to exist at that time. In the opinion of his contemporaries the bat, for example, was a flying thing and therefore a bird. Consequently it found a place in his Bird Book, but Gesner does not fail to note that the bat is much more like a "land-animal" (we would say, mammal). He deduces that it possibly forms a link between birds and mammals. This, of course, is a mistake; the bat is simply a flying mammal. But it shows that Gesner had ideas about possible relationships which had not previously been dreamed of.



THE NARWHAL

Gesner took this picture from Olaus Magnus, not knowing that this animal produced most of the tusks supposed to be unicorn horns

He encountered a similar inconsistency when, in writing his "Fish Book" he came to the hippopotamus. This animal was almost unknown to zoölogists of his time, and many were even doubtful about its existence. Gesner identified it at once as the animal he had seen represented on Roman coins. All reports, classical as well as contemporary, agreed that it was a water creature, and Gesner therefore gave it a place not in the first, but in the third volume,



THE UNICORN

Gesner wondered why this animal if it existed never had appeared in the Roman arenas, where every kind of beast, even the hippo, had been exhibited the one about fishes and other marine animals. But here, too, he made a remark which indicated that he was not content with so primitive a "filing system." What a system it was that would put an obviously terrestrial animal among the fishes!

He mentioned that he had received from a friend some teeth that were unmistakably from a hippopotamus. The incredible fact to him was that the friend had found them in a riverbed near his native Zürich. They were, of course, fossil teeth, remnants from the Tertiary age; but as geology did not exist in Gesner's time he was forced to compromise: "whether these teeth came from hippos, dragons or other cruel animals we will not decide now."

His works, the originals as well as the contemporary translations, are admittedly not free of error. They even contain a few of the myths and fables of the ancients. But Gesner, though he felt obliged to include such things, generally made it a point to express his doubts.

He reasoned, for example, that all the stories of half-men and tree-men, dwarfs and "forest-devils" were only misconceptions of monkeys and apes. He denied the story of the basilisk, and did not believe in the existence of sirens in the sea, or in the legendary bird roc, or the winged horse Pegasus. He ridiculed the seven-headed hydra and put the responsibility for the truth of the "sea wonders" on their reporter Olaus Magnus.

Sometimes he was uncertain. Dragons seemed to be fairly well authenticated, and he had seen "little ones"—probably tropical lizards, among them the variety from Java known even today as "flying dragons." While admitting that dragons possibly existed, he stated nevertheless that what was sold in the pharmacies under the name of "dragon blood" was not dragon blood and often not blood at all.

The question of the unicorn proved especially bothersome. All the ancient books mentioned it, to be sure, and unicorn horn was sold at exorbitant prices in every pharmacy. But nobody had ever seen the animal alive. Gesner published all available descriptions of the creature, and went so far as to say:

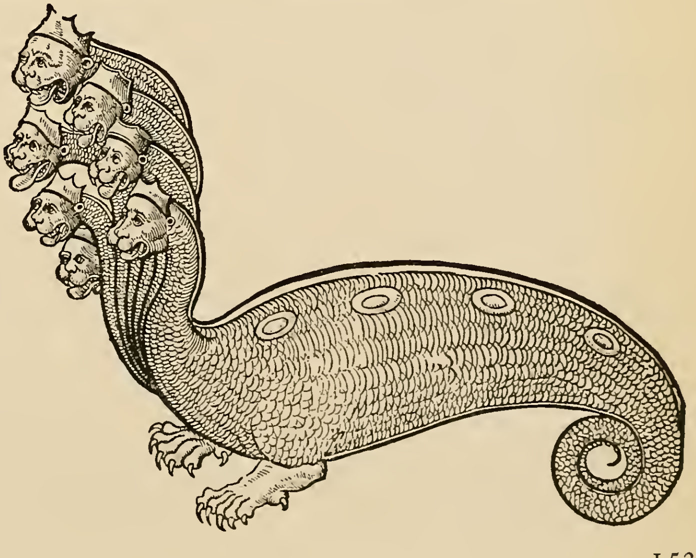
"Let us agree that India, Syria, and the Land of the Black People produce them, and let us believe in the narratives of the explorers as to where the horns come from."

It nevertheless worried him that the Romans had never had a unicorn in their arenas, where every possible kind of a beast was to be found.

In reality the "horns" were narwhal tusks. Gesner did not know this, though he had the picture of a narwhal after Olaus Magnus. Probably because he did not credit Olaus Magnus, this explanation did not occur to him.

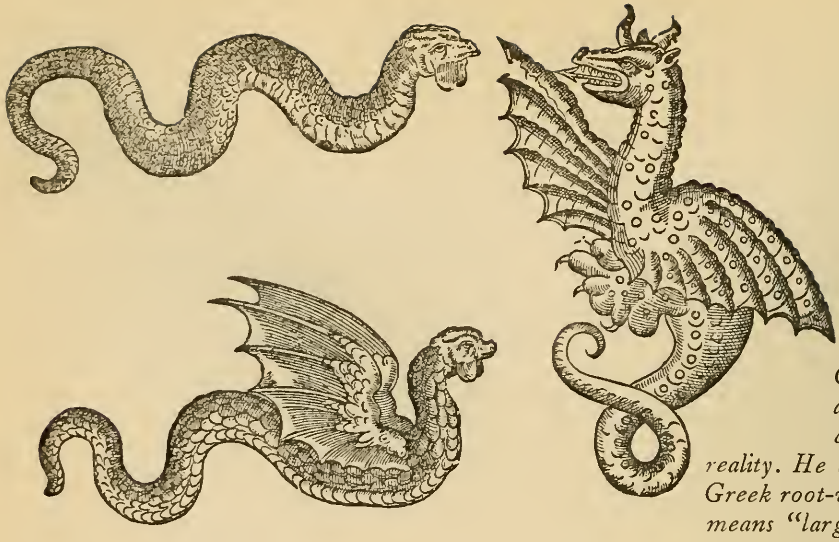
Of the creditable series of original zoölogical discoveries which Gesner made and published, a considerable number were not accepted as authentic until after being disputed by his successors.

The most famous case of this sort is his "*Waldrapp*" or wood-crow. Gesner lengthily described this bird, then existing not only in Switzerland but also in other neighboring



Seven-headed Hydra

Gesner ridiculed belief in this purely legendary creature

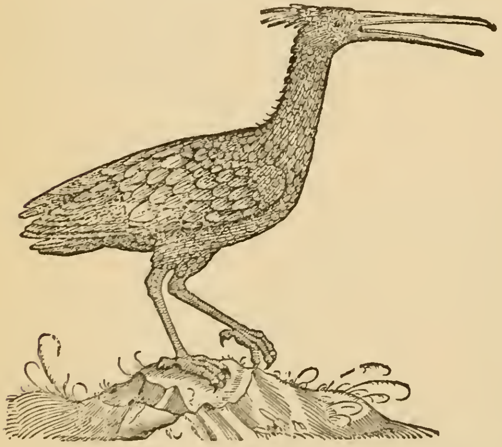


Dragons

Gesner depicts these dragons but is uncertain about their reality. He emphasizes that the Greek root-word drakon *simply means "large snake"*

European countries. He reported that he had found its stomach to contain bugs, beetles, and worms harmful to crops, which indicates that he knew the bird well. For this reason other authors of scientific books accepted the *Waldrapp* as existing, though they did not know it from personal observation.

The *Waldrapp* was a continental bird. English scientists following soon after Gesner had to rely on his authority concerning it. Ray calls it "Gesner's Wood-Crow"; Albin calls it the "Wood-Crow from Switzerland"; and Sir Thomas Lowther even possessed a specimen of the bird in his collection.



Gesner's Waldrapp or Wood-Crow

When Gesner's successors were unable to find this bird, they believed that he had been deceived, but he was vindicated when it was rediscovered three centuries later

This combined evidence convinced Linné that he should give a place to the wood-crow in his system, though he did not have direct knowledge. Because Gesner had reported that the wood-crow lived in secluded places, Linné introduced *"Upupa eremita"* as the scientific name, "eremita" meaning "hermit." A few years later he restored the original designation, *"Corvus sylvaticus"*—wood crow. Linné's uncertainty shows that he did not know the bird, and neither did the other naturalists of his period.

In 1805 Bechstein, the greatest authority of his day in ornithology, declared the wood-crow to be an error and omitted it from his *Natural History of Germany*. By then the bird was extinct in nature as well as in books, and a long time passed before the truth was discovered.

About thirty years later Professor Wageler discovered in Egypt a new variety of ibis, called *Ibis comata* or *Geronticus comatus*. By mistake this bird was included in Dresser's great "History of the Birds of Europe." This was wrong, for *Ibis comata* was *not* a European bird. But it was also right, because this ibis was Gesner's wood-crow, now extinct in Europe, but still living in Northern Africa. Yet it took seventeen more years to find out that wood-crow and *Ibis comata* were the same bird. Gesner's *Waldrapp* was rediscovered, its author vindicated—Gesner was right.

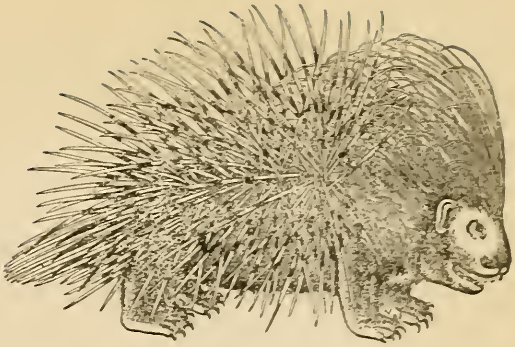
Another case of a belated vindication of Gesner is that of the porcupine. Gesner stated, probably for the first time, that the porcupine defended itself by "shooting" its quills. Later this idea was laughed at (Buffon was the first to doubt it), and all books declared that porcupines did *not* shoot their quills, in spite of the common belief. More than 300 years after Gesner, Professor Dr. Vosseler, director of the Hamburg Zoölogical Park, repeatedly found quills not simply in the cage of the porcupines but in the neighborhood, sometimes as far as fifteen feet away and occasionally even sticking into the cloth with which the cage was covered. The truth is, of course, that the quills are only loosely attached to the skin of the porcupine and that a few are always likely to drop out when the animal erects them very quickly in defense of a real or imaginary danger. When swung around violently in anger or fear they may fly out and possibly hit an enemy. Gesner's report proved an exaggeration of observed facts, yet essentially he was right.

Gesner was the first to mention the humming bird; he gave the first description of the canary bird; he discovered the Alpenflüevogel.

Incidentally, in one of his smaller books he made the first mention of a pencil. His illustration, which is the oldest known picture of a pencil, shows a mechanical variety, indicating that the refillable pencil is the older form.

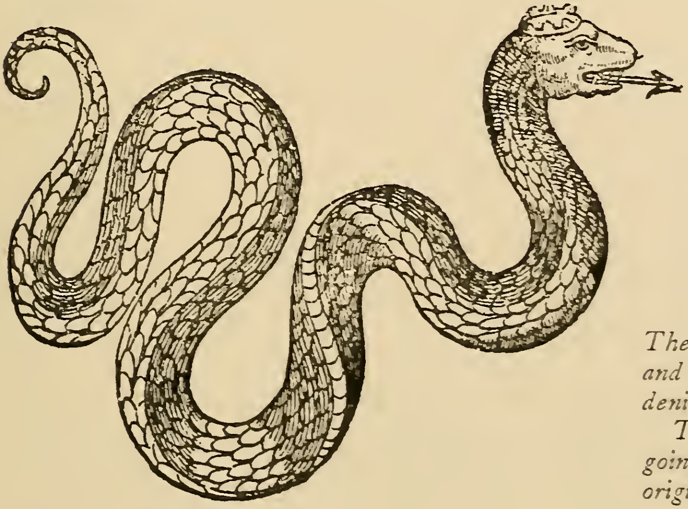
Though only a short medical book by Gesner appeared, which is simply a collection of prescriptions, it would be unfair not to mention the fact that he won high repute as a physician. From a passage in one of his letters we can even deduce that he discovered what was later called autosuggestion. Discussing the value of a few especially favored and highly priced medicines, he expressed his opinion that the so-called "liquid gold" must be useless. It was prepared by pouring boiling wine over gold, under the assumption that the wine dissolved a part of the metal. Gesner declared that gold cannot be dissolved in wine, and that the medicament could not therefore cure an illness, or "if it cures, it is the wine, the other ingredients, or the belief of the patient."

Although this passage sounds wholly natural to us, for centuries it was laughed at by the physicians. How ridiculous that belief could cure! We know now that in some cases it can, and once more the Father of Zoölogy, even when speaking as city physician of Zürich, was right.



THE PORCUPINE

Gesner defended the belief that the porcupine can shoot its quills



THE BASILISK

The basilisk was pictured with a crown and called the king of animals. Gesner denied its existence.

This picture, as well as all the foregoing ones, are taken from Gesner's original works

Buffalo Hunt—1935

Airplane, pack horse, and dog sledge carry a modern museum expedition to the last refuge of the wood buffalo

By George G. Goodwin
Assistant Curator, Department of Mammalogy,
American Museum

On the morning of August 13, 1934, between dawn and sunrise, not a breath of air stirred the mirror surface of Cooking Lake. Without a breeze our overloaded plane could not rise into the air for its flight into the northern wilderness.

In advance of the sun a veil of mist was rising from the glazed water. Shrill cries of shore birds sounded across the lake from the low gravel beach. Then, with the first glint of the sunlight, fleecy clouds turned to gold, and the necessary breeze rippled across the glassy surface.

With open throttle our plane zoomed across the water and rose. The reaching tree tops fell below and we flashed upward into the open sky. We swung northward, and climbed. The air was crystal clear in the direction of our objective, Pine Lake.

The major purpose of our expedition into subarctic Canada was to obtain typical specimens of wood buffalo for the American Museum of Natural History, and a group for the National Museum of Canada.

The flight to Pine Lake

The exact relationship of this race of animals has been under dispute. Most authorities regard it as a valid species, distinct from the more familiar plains bison, from which it is segregated by natural boundaries in the form of gigantic rivers, lakes, and huge areas of almost impassable muskeg. Some zoölogists believe, indeed, that the wood buffalo is more closely related to the European bison than to the typical American variety.

With the wind singing wildly through the struts of the plane, we passed over the low flood plains of the Athabasca, Peace, and Slave rivers, vast areas of delta marshes and abandoned river channels. At about three o'clock we saw the glint of water through the scattered clouds, a strip of silver between the dark spruce trees. Nosing downward, we alighted almost without a bump on Pine Lake.

Here was our immediate destination. The facilities of modern invention had enabled us to land in the heart of the early summer range of the wood buffalo, a desolate waste which a few years ago could not have been reached without months of tedious travel. But the task of securing our specimens was nevertheless a difficult one.

Lying about fifty miles south of Fort Smith, Pine Lake stands a little higher than the salt plains to the east. Its thick forests afford protection for the buffalo from the myriad insect pests which infest the country in June and July.

We scouted through the woods on horseback and found recent signs of buffalos, particularly in the form of "wallows," most of which were in open spaces in the forest. These wallows are saucer-shaped depressions about ten feet in diameter, where the creatures have rooted up the turf and rolled in the dirt to facilitate the shedding of their hair and to dust their hides with loose soil as protection against the flies. The high hump on the backs of these animals, unlike that of the plains buffalo, seems to obstruct this operation. We later saw a number of old bulls in the act of rolling, but they never seemed to succeed in turning completely over. They also enjoy rubbing their shoulders and necks against tree stumps, and take particular satisfaction in tearing small spruce trees to shreds.

Our horses were restless, and shied at every shadow that looked like a buffalo. We presently learned that it was never safe to take chances where there was possibility of an encounter, for, rounding a sharp bend, we unexpectedly met an old bull apparently retracing his migration route. The old warrior was not to be deterred from his course. Rooting up a cloud of earth, he charged directly through the center of our outfit, scattering us to right and left, then continued on his way.

When on the move, wood buffalo pay little heed to anything in front of them, and when they charge, if a man falters, he is liable to have small chance of avoiding their mad rush in the willows and thick timber. On the other hand, they appear timid of any possible danger from the rear. Once on the run they seem consumed with terror, and plunge headlong into the forest.

Their eyesight is not good, but their senses of smell and hearing are keen and unless one stalks them stealthily upwind, there is little chance of getting within rifle range. A band of five or six young animals that started about a thousand yards downwind from us, went crashing through the forest at an amazing rate; and though we followed them some distance, we finally lost them.

From the general scarcity of the creatures here we concluded that, with the worst of the fly season over, they must be moving toward the salt plains, where more abundant forage was available. So we determined to proceed in that direction.

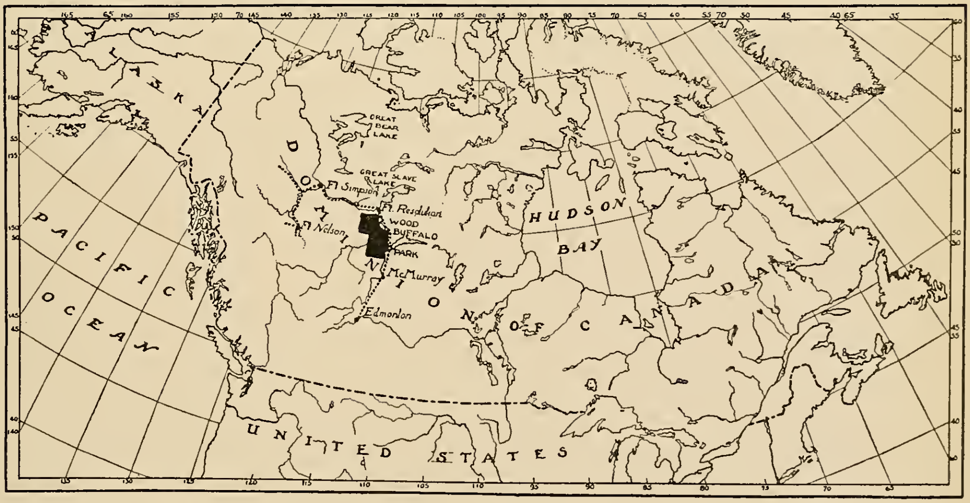
About three o'clock a thunder storm which had been threatening all morning broke. The rain came down in a steady torrent, and we pushed on through dripping trees until a suitable place to camp was located near a fresh-water marsh.

Stampeding buffalo

The following day we continued toward the salt plains. We alternately passed through thick forest and muskeg, the horses floundering with difficulty through the frequent mud holes.

A big garter snake a yard or more in length slithered across the trail at one point. It was apparently the first of its kind to be reported in this region.

Soon we were out of the timber. Thereafter strips of grassy meadow between areas of willows offered good cover and better travel.



THE WOOD BUFFALO PARK

This isolated preserve shelters some 2000 of the once abundant wood buffalo. Specimens of the animal and information regarding its habits were an objective of the Snyder-Canadian Expedition. The dotted line marks the route flown by the expedition

At the edge of a water hole we spied a small herd of buffalo feeding. Hiding in the thick brush, we studied their movements as they grazed, and noted that they were idling toward us. Then from the right along the lake shore came an old bull, traveling rapidly. His shoulders, which reached well above the willows, must have been close to seven feet in height. Presently he halted, suspicious, and remained back among the willows, out of rifle range. Then the herd got our scent and stampeded. Their motion as they galloped off might best be described as a series of bounces, with all four legs operating together quite stiffly. The big bull likewise made off and, though we tried to follow him, he succeeded in quickly putting distance between us.

There was good grazing here, where the open meadows were broken only by occasional clumps of spruce and pine and extensive thickets of willows. And here we struck the main artery of the migration route. It led toward the salt plains in a single path beaten hard by trampling hoofs and branching out in the muddy sections into seven or eight deeply trodden furrows. Following it, we frequently noted tracks of big timber wolves. Once we saw a coyote slink away through the brush.

A splendid specimen

The buffalo we had seen were still keeping close to the woods, and we discovered no fresh signs of them on the open salt plains. Swinging back to the edge of the timber, therefore, we were rewarded by the sight of a fine big bull just emerging. But he saw us at the same instant and made off across a salt creek, disappearing into the woods beyond recovery.

Entering the willows again, we presently made out the dark outline of a huge brown hump above the thickets. Fortunately we were downwind, and dismounting, we were able to push our way closer through the dense bushes. He was a magnificent creature, which, if the difficulties of transportation did not defeat us, would make a splendid museum specimen. After careful maneuvering we finally secured him, and ascertained that he measured six feet six inches at the shoulders.

It was now late in the evening and, though the days were long, it was all we could do to remove the skin before dark. The hide around the neck and horns was an inch thick and the four of us had a struggle to turn the animal over.

We constructed a travois of dry spruce poles upon which to drag the animal away, but this proved a complete failure. The horse to which we hitched it bucked, jumped, and kicked until free of all impediments.

Salting the skin overnight and drying it out the following day reduced the weight sufficiently to permit our packing it on our strongest horse. The skeleton was divided among the rest of the animals, and thus we were able to get back to our base camp.

Days were slipping by and the chances of getting a complete series of wood buffalo in the time at our disposal were not promising. Packing a light outfit, we set out again to follow the migration route. The weather was overcast. The first day a few old bulls, usually in pairs, were seen. But these were plains buffalo which had been imported from the herds at Wainwright to replenish the diminishing woodland species, and were not what we were after.

While we were eating lunch on the bank of a fresh-water lake, the roar of a bull drifted down the breeze. At intervals of a few minutes the sound recurred. As it was distinct only when the wind was exactly right, we knew that the distance must be considerable. A dense wet mist enveloped the trees and willows, blotting out all the surrounding landscape. We worked upwind, guided by the often repeated roar, and drew quite close before the gigantic forms of a whole herd loomed up through the mist. When the fog cleared, we counted thirty animals, feeding on an open meadow. The old herd-bull was wandering restlessly about, apparently expecting a rival, which presently burst into view.

The battle

With a roar the intruder challenged the herd-bull, and a furious battle ensued. The two charged, backed off, and charged, time and again. The rival was younger and, if not more powerful, was more agile. The old warrior, realizing his opponent's superiority, at last resigned himself to defeat and made a sedate exit into the forest. The conqueror then challenged each young bull in turn and settled down to rule. To our extreme disappointment, however, not one wood buffalo was included here—they were all plains animals.

The sound emitted by an old bull is like the deep guttural roar of a lion. To realize its full force one must hear it in the dead of night as we did from our lonely camp at the edge of the salt plain. The roar came suddenly, not twenty-five yards from the canvas shelter beneath which we slept. We all sat bolt upright, for an old bull which has been deprived of his harem, like the one we had recently observed, does not make an ideal partner for a midnight tryst. By the glow of two broad streaks of northern lights we discerned two aged bulls, apparently out to fight a duel. Fortunately they were too much interested in sizing each other up to molest us. But again the animals were plains buffalo.

Of wood buffalo we had secured only one. Day after day we combed the forest and salt plains, but without success. To make matters worse, the expedition had a date with a pack outfit a thousand miles away in the peaks of the Rocky Mountains in British Columbia. Somewhat disheartened but intent upon returning in a few weeks to complete the series, we at last had to depart for the Rockies by plane.

Early snow storms delayed our return, but we managed to land back at Pine Lake on September 23. Many of the smaller lakes were now frozen over. The ground was crusted with frost, and the chill of winter was in the air.

Packing our outfit on horses, we traveled eastward toward the salt plains, and camped at night on the bank of a creek. Early the following morning we scoured the grassy meadows.

When we spied three young buffalo sunning themselves on a bank we felt that luck was with us, but they dashed off through the water and were lost.

More group material

It was on a marshy plain broken by areas of willow trees that we met with real success. The herd which we sighted there and studied through our field glasses were unquestionably wood buffalo and included several fine specimens. Leaving our horses with the warden, we made a wide detour to leeward. Then wading through wet marsh behind an islet of spruce trees and willows, we succeeded in approaching within range. Our patience was rewarded by the acquisition of four specimens: two cows and two bull calves.

Sudden activity then threw us on our guard. The herd leader sighted us in the open and, apparently excited by the smell of blood, made a direct charge. Our desire to secure photographs of the animal in action caused us to wait longer than was altogether safe, and the ferocious creature gave us a few tense seconds before we could bring it down. The rest of the herd, deprived of their leader, swerved and plunged into the forest. While skinning the specimens we had secured, we saw several bears rear up on their hind legs in the surrounding tall grass to see what was going on.

Winter flying

We still needed one more old bull to complete our series. Snow was beginning to fall, and we were reminded that the season was well advanced. A few more days were all we could expect before the freeze-up. And when once the rivers froze, there would be no hope of flying out before the onset of winter. The chances of securing the other bull were too slim to hazard. So we reluctantly returned to where our plane awaited us at the Government Hay Camp on the Slave River, resolved to come back equipped for winter flying and winter travel.

It was March before we could return, with renewed determination to get that last bull. Our plane landed us on the ice of the Slave River on the 25th. The north was still in the grip of winter. The temperature registered 30° below, and a stinging wind driving a fine, powdery snow greeted us as we landed. Ranger Mike Dempsey met us with dog teams.

Two days of fast sled travel brought us to the edge of the salt plains, great expanses of wind-swept tundra. We made a long trip to the north. The snow was soft and deep, and travel through the underbrush on snowshoes was difficult. But where the crust on the snow was strong enough to hold the dogs we made good time.

Rounding a clump of pine trees, we saw two big bulls rooting under the snow for grass. We left the dogs and started through the bush. But we had gone only a few yards from the sledges when the dogs started to howl, and away went the buffalo. They plowed off through the deep snowdrifts with perfect ease. We followed in their wake for several miles; but it was impossible to keep up. They were traveling at a gallop when last we saw them.

The next trip was down the salt creek. The sledges ran smoothly on the even snow, and we were able to cover considerable distance this day. We saw about ten buffalo at one bend in the river, but there was not a really big bull in the lot, so we let them go.

The long trek to camp revealed nothing of particular interest. The wind was rising, and it bit into our faces severely when crossing open spaces. That evening a pair of mock suns, or sun dogs, appeared distinctly above and below the sun. This spectacle is caused by the presence of ice crystals in the air. The wind began to whistle through the pines and dark clouds were gathering in the north.

The following morning a stiff wind was driving fine, dry snow, and as the day progressed a blizzard developed. While it raged we had to remain in camp. The temperature ranged between 10 and 30 below, but our tent fortunately was of strong canvas, and though we were cold, we were none the worse for the experience. Later I learned that the wind had reached a velocity of sixty miles an hour, and the plane which was at Fort Ray had to be fastened down by eight one-hundred-gallon cans of gasoline.

Mike told us that he had seen two wolves run into a herd of buffalo, but the latter paid not the slightest attention to them and continued to graze. This astonished him as it is generally believed that the wolves frequently kill buffalo. An examination of the food eaten by six wolves killed at this time showed not a trace of buffalo meat.

Good hunting weather

After the storm the sun came out and the sky was blue and clear. The temperature dropped to 35 below, and prospects for good hunting weather were favorable. We left camp at about 7:00 a. m. and made a wide circle over the salt plains. But we saw no signs of buffalo here. The biting north wind had apparently driven them into shelter.

Striking off toward the timber, the dogs became interested in a particular growth of willows and spruce trees some five hundred yards away. They frequently looked in that direction, and as we passed on the leeward side, they seemed loath to leave it behind. Some creature was undoubtedly hiding in that cover, and we finally determined to investigate.

Entering the brush some distance beyond, we worked along to the spot indicated by the dogs. Here we found fresh tracks of a big bull that had been rooting under the snow. There were spots of blood where the animal had cut its muzzle on the sharp crust. Crossing a low ridge and straining our eyes through the thickets, we saw a big, dark shadow not more than thirty paces away. It was a magnificent bull buffalo of the woodland variety. Here at last was the animal that would complete our series.

The end of the hunt

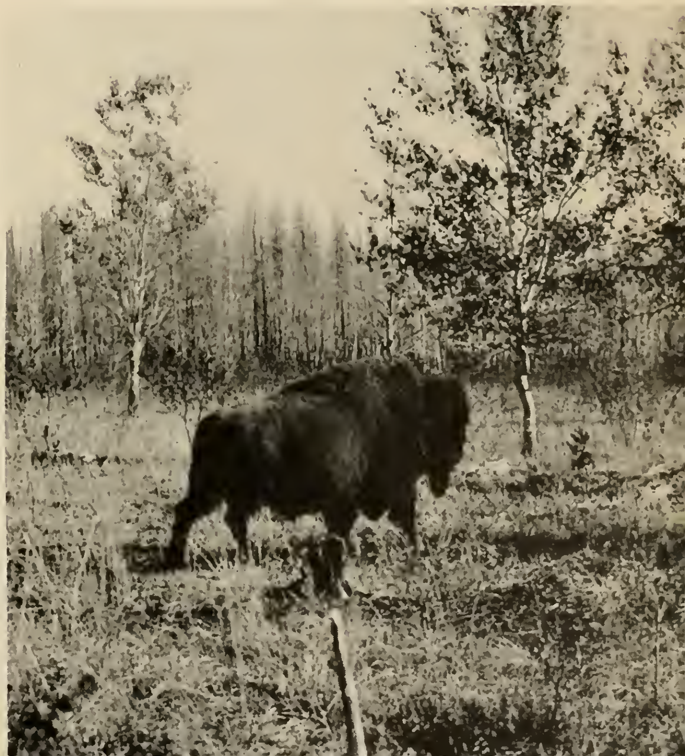
Our suspense after such a long search can well be imagined. Experience had taught us how difficult it often is to bring down one of these animals; and we knew that if we lost this specimen we might not find another equal to it without tedious efforts involving repeated disappointment. Steady yet instantaneous nerves tempered with more than ordinary patience are the primary requisites in big game hunting. In maneuvering to secure this animal, the need of success caused us to take every precaution. The shot was fired with breathless anxiety; and in a moment, that tense interlude during which the hunter is uncertain whether his quarry is unable to charge, was safely passed.

Measurements proved that he had stood six feet seven and one-half inches at the shoulders. As so often seems to happen, the specimen was secured at sun-down, greatly increasing the difficulties of skinning it. The intense cold froze the hide as we peeled it off. Working by the light of towering log fires, we were kept busy far into the night.

Three campaigns into this wilderness had been necessary to attain our objective, but the results amply rewarded all our exertions. We had secured the quota of animals which were to be divided between the American Museum of Natural History and the National Museum of Canada, so that each would receive a group comprising a bull, a cow, and a calf. It is not easy to hunt this animal, owing to its scarcity and the inhospitable nature of the country. But our patience was the more rewarded because the individuals we selected were magnificent representatives of their race, perfect in every respect.

In Quest of Wood Buffalo

An airplane sped the Snyder-Canadian Expedition to a desolate region which a few years ago could not have been reached without months of tedious travel



The wood buffalo is larger, darker in color, and shaggier than the plains bison. Most authorities regard it as a separate species, but as a pure race it is probably disappearing. (Copyright photograph by F. H. Kitto, Department of the Interior, Ottawa)

(Above) A member of the expedition scouting through the subarctic forests. Buffalo tracks were plentiful, and the horses shied at every shadow

In winter the range of the wood buffalo lies white under subzero temperatures, and dogsleds are the only mode of travel

Day after day the expedition with light equipment combed the forests and salt plains

(Above) The wood buffalo is difficult to obtain because of its keen scent and hearing. When the party had secured all but one of the desired animals, the onset of winter interrupted their quest

(Below) Equipped for winter travel, the expedition renewed its campaign. After landing on the ice of the Slave River, the party continued the journey by dog-sled

The buffalo root for forage through the crusted snow with their muzzles

The last specimen collected by the expedition was a magnificent bull standing six feet seven and one half inches at the shoulders

Salamanders

Modern representatives of the first back-boned animals to live on land

By CHARLES E. MOHR

Naturalist, Public Museum, Reading, Pennsylvania

SALAMANDERS—creatures of fire or of icy coldness, amphibians or reptiles, poisonous animals or harmless?

From ancient times they have been creatures of controversy; even today they are the subject of false notions and absurd superstitions. What are these salamanders?

The name itself is less familiar than the animal, for every youngster who has turned over a rock on the hillside or who has peered into the depths of a spring or under the stones in the creek knows what "lizards" are. For he has caught the slippery, squirming things, and proudly borne them home in a commandeered milk bottle or discarded tin can, only to have his mother throw up her hands in alarm and warn him that they will jump down his throat and live in his stomach. Or, if a wiser and more tolerant parent expressed no alarm at the sight of the "spring lizards," the youngsters would soon discover that the little animals had dried up and died.

Salamanders vs. lizards

This tendency of the skin to dry is characteristic of salamanders and illustrates the chief difference between the common "spring lizard," or salamander, and the true lizard. All salamanders have moist, glandular, and scaleless skin; whereas all lizards are scaled, their skin being hard and dry. Salamanders, requiring moisture to live, frequent springs, wet moss, and bark, or the damp earth under boards and stones. Lizards, on the contrary, avoid water and are found most often in dry, sandy places, or clambering up the trunk or branches of trees, hunting a spot where they can bask undisturbed in the warm rays of the summer sun. Salamanders are amphibians, related to the frog and toad, and like them pass through two distinct life stages after hatching out of the egg—larval and adult. Lizards are reptiles and show their relationship to the snake, the turtle, and the alligator in numerous characteristics, particularly in the absence of a larval stage in their development. They are hatched as miniature adults.

A knowledge of the habits of salamanders explains the first paradox that their name suggests. That is, the relation between the superstitious belief in the salamander as an animal born of fire and its known aversion to anything hot and dry. The mythical fire-haunting salamanders are best represented by the European "fire salamanders," *Salamandra salamandra.*

Fire salamanders

For centuries past peasants and nobles alike have been startled by seeing this creature come crawling out of the fire as they threw logs on to the blazing hearth. That they actually saw salamanders is not to be doubted; but their assumption that the salamander made its home in the fire and that it could withstand flame was erroneous. Obviously, the salamanders had hidden themselves under the bark of the log or in the dark dampness of its crannies while it lay in the forest and thus were brought indoors as wood was gathered. When placed in the fireplace, they were driven out by the heat, which was no more pleasant to the unfortunate fire salamander than it would be to a human.

The term salamander has been borrowed for technical use to describe instruments used in fire, such as the metal drum in which coals are heated for drying plaster, and for the slag remaining in the metallurgist's furnace after the fires are drawn.

In contrast to legend is the fact that salamanders are among the animals most tolerant of cold. For there are blind cave salamanders which spend their adult life in the cold and darkness of subterranean streams, and others which dwell in the ice-fed waters of mountain streams. I have seen salamanders migrate even through the snow to the icy waters of woodland ponds to lay their eggs among pieces of floating ice.

A crucial stage in evolution

Hardy creatures, these salamanders; and of ancient and honorable lineage. They represent a crucial stage in the evolutionary development of the higher back-boned animals. The amphibians became indeed the masters of the earth, the dominant form of life in the coal forests of the Carboniferous period. And only after millions of years did they give ground to the larger and apparently better adapted reptiles. The salamanders living today represent merely a remnant of their fossil ancestors. In Stejneger and Barbour's "Check-list of North American Amphibians and Reptiles" just eighty-six species are listed for this continent north of Mexico.

Just how crucial the transformation from fish to salamander must have been, may be realized if one compares the anatomical features of the two. As Noble points out, however, the ancestors of the salamanders could not have been fish of the type of our modern ones, considering the tremendous changes of structure which would be necessary for the transformation of the modern fish into a salamander. For instance, the gills would have to be replaced by lungs, with a nasal passage developing to take in air when the mouth is closed. The fins and body would have to become adapted to land locomotion and the skin modified to prevent drying. Then, too, specialized glands would be needed to keep the mouth and eyes moist, with softer eyelids developing out of folds of the skin. The sense organs would also be modified, those of the lateral line disappearing as the auditory, optic, and olfactory centers became more highly specialized. Finally, the eyes would have to be raised above the surface of the skull if they were to be at all efficient.

Obviously such a transformation could not have been a sudden one. And there is considerable fossil evidence which indicates that all the fishlike forms from which the large and numerous ancient salamanders developed probably were considerably different from modern fishes.

Among the most unusual modern salamanders are the extraordinarily large *Siren* of the southeastern states, an eel-shaped animal with branched external gills and a single pair of limbs; *Amphiuma,* the "Congo-eel," which superficially resembles the last form but lacks external gills while possessing two reduced pairs of legs; and the flat-bodied, stout-limbed hellbender, *Cryptobranchus,* also without external gills.

This latter creature, the hellbender, is a large, aquatic salamander of the mountain streams of the eastern states. It has a bad reputation among fisherman and has little competition for the title of the ugliest salamander. Though it reaches a length of eighteen inches, it is nevertheless dwarfted by its Japanese relative, the giant *Megalobatrachus,* the world's largest amphibian, which attains a length of at least four feet.

Still another group includes the gilled mudpuppy, *Necturus,* which may be thought of as a permanent larva although it becomes sexually mature and reproduces. This peculiar condition is called neotony, and is explained by the conjecture that the adult stage has been lost during geological history, the larval stage assuming the reproductive function.

Scarcely less remarkable than the "permanent larvæ" are those salamanders which develop on land and so require the passage of the whole larval life within the egg.

The red-backed salamander

By far the most common of the terrestrial species in the east is the red-backed salamander, *Plethodon cinereus.* While these salamanders are most frequently seen in wooded areas where rotten logs and stumps provide food and shelter, they may be found almost as often on mountain slopes or under rocks in abandoned fields.

I have found eggs of the red-backed salamander as early as the middle of June, but the egg-laying may continue into September. Most commonly the eggs are found in a cavity in a rotten log. The female usually lays three to thirteen eggs and attaches them to the roof of the tiny chamber. As each egg is laid separately and adheres to those previously laid, the fused outer capsule serves to hold the eggs together, the mass usually taking the form of a bunch of grapes. The female coils around the eggs, probably as a means of keeping them moist.

The developing embryos have large external gills which are usually lost before hatching. By this time they have the same form as the adult, although they are only three quarters of an inch long. The adult itself is seldom more than three inches in length.

Many salamanders manage to escape observation because of their small size, practically all of the commoner species being less than eight inches in length. The larger of these are further protected by spending their larval life in the water where their inconspicuous coloration makes them practically invisible. Salamanders elude observation chiefly by hiding away in the daytime, or almost continuously as in the case of the larger terrestrial species which are seldom seen except during the breeding season. At night the smaller species may be seen in numbers on the forest floor or in low bushes, but during the day they hide away under logs or stones, in bark or moss, or in cool, dark holes, under the overhanging banks of streams.

Blind salamanders

Some salamanders shun the light to such an extent that they have lost the use of their eyes. This is true of the blind cave salamander, *Typhlotriton spelaeus*, of the Ozark Mountains in Missouri.[1] This cave-dwelling amphibian is characterized by translucent skin which is practically without pigmentation. Strangely enough, the larvæ of *Typhlotriton* are densely pigmented and have well developed eyes. After two years of larval life in the springs or colder streams, they resort to the caves to transform into adults. A number of destructive changes accompany metamorphosis—the eyeballs withdraw somewhat into the head, the retina degenerates, and the eyelids fuse together, although the dark eyeballs still show through them. Laboratory experiments with *Typhlotriton* larvæ brought to the American Museum of Natural History from the Ozarks, demonstrated the amazing fact that individuals undergoing metamorphosis in the light *retained serviceable eyes*. The lids never fused nor did the retina degenerate. On the contrary, the eyes developed more fully. Further, these individuals were distinctly darker than those which transformed in darkness. These investigations show that the apparently unfavorable cave environment has produced no permanent effect on the eyes or coloration of this salamander, for, while this loss of sight has occurred in every generation, perhaps for centuries, there is no evidence of this environmental effect becoming inherited.

The dusky salamander

Another species in which the larval life has its origin in a habitat differing from the normal haunts of the adult, is the common dusky salamander, *Desmognathus fuscus fuscus*. The salamanders are abundant in the wet leaves about springs, and along the smaller woodland streams. During dry spells they are likely to be concentrated in the muddy pools of partly dried creek beds. They burrow in the soft, loose earth, working through rotten logs and débris of the forest floor, and come eventually to water.

The egg-laying season may start in June but greatest activity occurs about the middle of July, and eggs may be found throughout the summer since they take about eight weeks to hatch. The eggs are found in a variety of situations, but the greater number including the ones illustrated, are located within a foot of the water, frequently under flat stones in the damp earth near a spring. The egg clusters are usually small, numbering from twelve to twenty, but occasionally they are considerably larger. The cluster shown in this article, taken the day before the larvæ hatched, contained forty-two eggs, all of them developing. The outer envelope of each egg forms a stalk by which it is attached to the main stalk of the mass.

When the young hatch, they do not go immediately to the water. About two weeks pass before the larval dusky salamander takes up completely aquatic life, developing a tail fin and gills. They transform into adults during the following spring.

---

[1] An article on the blind cave salamander was published in NATURAL HISTORY for September-October, 1927.

Most salamanders do not lay their eggs wherever they happen to be at the onset of the breeding season, but migrate to the places best suited for the purpose. This is well illustrated in the case of the four-toed salamander, *Hemidactylium scutatum*. The breeding habits of this form are unique in that they represent a transition between the purely aquatic development of the more primitive salamanders and the land-breeding habits of the dusky and the red-backed. The four-toed salamander usually passes the winter, and in fact all of the year except the breeding season, in woods comparatively distant from water. Early April finds the female salamanders on the move, headed in the direction of a marsh or a pond. Here they take to the water, and swim until they locate some tiny island knoll or a spot along shore where sphagnum or other mossy or grassy hummock provides a growth sufficiently loose for them to weave in and out among the strands, laying eggs as they go.

The eggs are more numerous than those of the related red-backed salamander, but there are probably not more than forty eggs laid by a single female. Nests of several hundred are sometimes found, but these undoubtedly represent the sets of many individuals. As the larvæ hatch, they are able to drop into the water a few inches below. After about six weeks the larvæ transform and take up the terrestrial life of the adult.

Regeneration of lost parts

The tail of the four-toed salamander is modified seemingly in anticipation of being lost, for it readily breaks off at the base. This probably represents a protective device. At any rate, on several occasions I have turned my attention to the twitching tail of a salamander at which I had snatched, only to find that the tail-less salamander had taken advantage of the momentary delay to escape. Similarly, it is true of other terrestrial salamanders that they will leave part of the tail in the hand which attempts to seize them. The lost parts are regenerated, however, an adaption that seems highly important to aquatic larvæ and terrestrial adults which not infrequently lose a leg or a tail in the struggle for existence.

The breeding habits of salamanders are often extraordinary in character. There is usually a well defined courtship of the female by the male, after which the male deposits a spermatophore, a gelatinous-stalked sac of sperm cells which is later taken into the cloaca of the female, fertilization of the eggs ensuing. Unfortunately the details of breeding are rarely witnessed. The habits of the terrestrial species are very incompletely known.

The pond breeders

The pond-breeders, particularly the ambystomids, offer the greatest opportunity for observation. The life history of the spotted salamander, *Ambystoma maculatum*, has been most completely studied, but recently I have had unusual opportunities for observing and recording the activities of Jefferson's salamander, *Ambystoma jeffersonianum*, which I will describe briefly.

Jefferson's salamander is a rarer and slightly smaller species than the spotted, seldom reaching a length greater than seven inches. Despite the fact that it ranges from Hudson Bay to Virginia and from the Atlantic Coast to Arkansas, the retiring habits of this species have made it one of the rarest in most localities. Unlike the terrestrial salamanders which guard their eggs and developing larvæ until they hatch, Jefferson's salamander deposits its eggs and then disappears, abruptly and completely. In fact, in certain parts of its range the salamander practically never is seen except for about a week each year during the breeding season. No doubt these salamanders have extensive burrows underground where they find sufficient food, so that few causes other than those related to breeding are sufficient to bring them to the surface.

In the eastern states Jefferson's salamander emerges from hibernation when the first warm rains of late March thaw the frozen hillsides of its woodland retreat. At times I have seen them migrating at night through patches of snow to reach the woodland ponds where they lay their eggs. Normally, however, evidence of winter is limited to remnants of rotting ice in portions of the pool. Prolonged warm rains at night sometimes stimulate large migrations, and I have seen as many as two hundred adults in a single pond.

Once in the water, the bizarre courtship ceremony, the *Liebesspiel*, begins. The males, which are about as numerous as the females at the beginning of the migration, court them, prodding and rubbing them with their heads, finally swimming over and grasping them behind the shoulders, in what one observer aptly termed a "piggy-back ride." This ritual apparently serves the purpose of stimulating the female to pick up the spermatophore which the male deposits near by. The spermatophores are quite small, about six millimeters in height, and because they are transparent except for the tiny white sperm sac on top, escape the notice of all but the most patient searchers.

Egg-laying

Egg-laying usually occurs during the second night following the *Liebesspiel*. A visit to a pond on such a night would reveal dozens of female salamanders clasping overhanging branches in the water or clinging to the stems of dead water plants. As many as a dozen individuals may be laying eggs at one time on the branches of a single water plant. One female may produce three hundred eggs, although half that number is more nearly the average. The eggs normally are deposited in masses of ten to forty, with an average of about twenty. They are within a gelatinous mass which is quite small at the moment of deposition, but within a few hours it absorbs a large quantity of water and fuses with other masses adhering to the same branch.

The larvæ, which need no guardian, develop rapidly, hatching from the egg capsule at the end of four weeks. As might be expected of aquatic larvæ, they show adaptations to pond life. They are equipped with external gills, broad bodies, and tail fins; in addition they have a curious pair of rodlike balancing organs which are formed even before the legs. The legs soon appear, however, the front limbs developing first, a character that readily distinguishes them from the early stages of the wood frog larvæ which occupy the same pools.

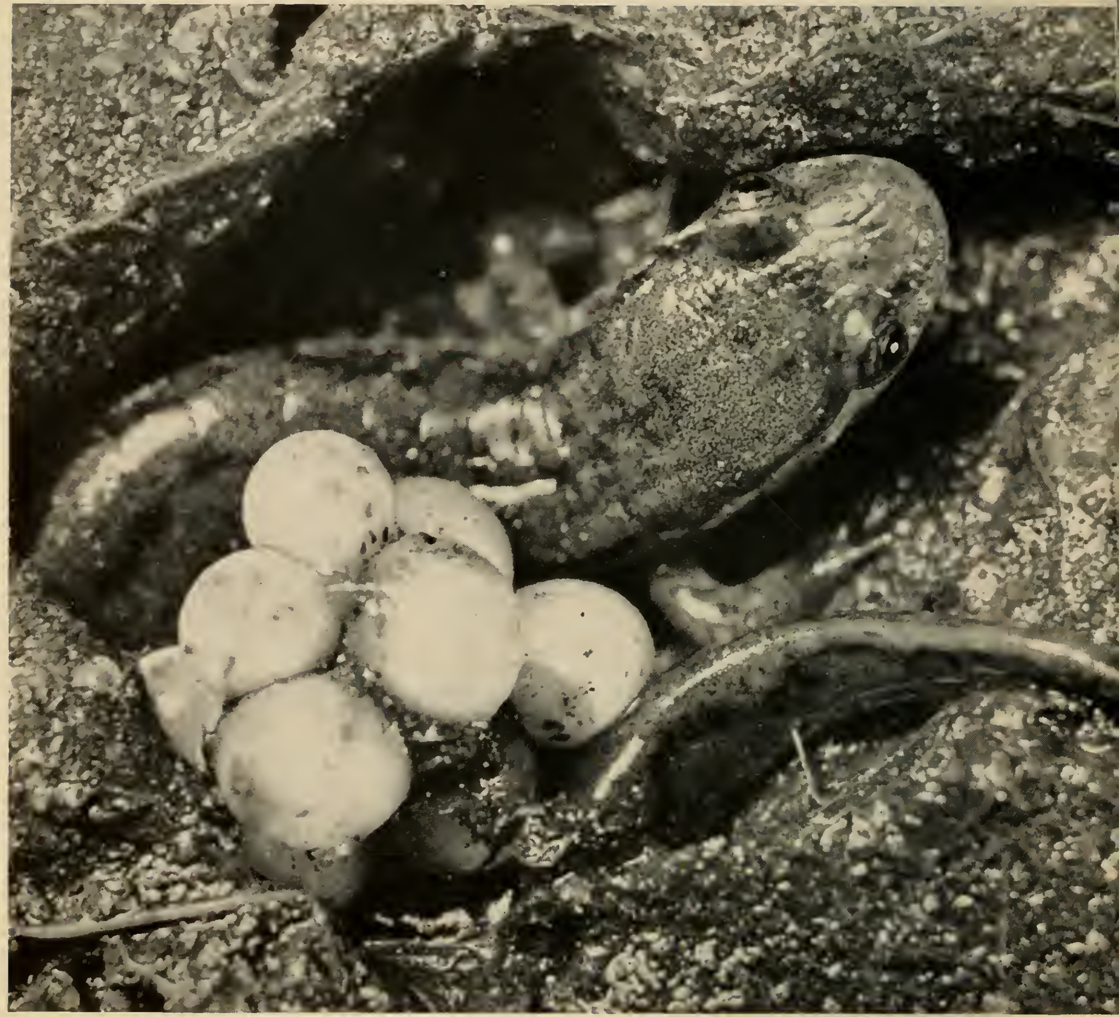
Since ponds usually dry up before the end of the summer, metamorphosis is governed somewhat by climatic factors. They are usually ready for terrestrial life by July, metamorphosis consisting principally of the loss of the branched external gills, a change in the structure of the skin, as well as certain skeletal modifications.

Valuable scientific observations

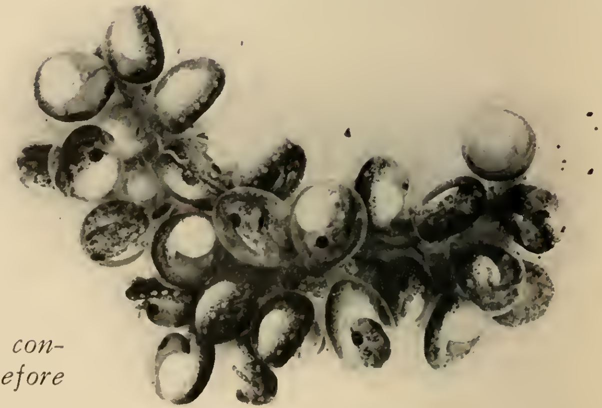
While the recital of facts regarding the life history of some of the most common salamanders may seem complete, there are many gaps in our knowledge that remain to be filled. Observations on the breeding habits of even the commonest salamander may prove of definite scientific value. Local naturalists can gather valuable data, since even locality records, when exact, are important in piecing together a picture of the distribution of a species. In addition, notes on habits including information as to the dates of appearance and disappearance and of egg-laying should be of interest to naturalists in the local field.

It is probably true that no other vertebrate group provides a more fascinating and fertile field for observation with the material so close at hand than do the salamanders.

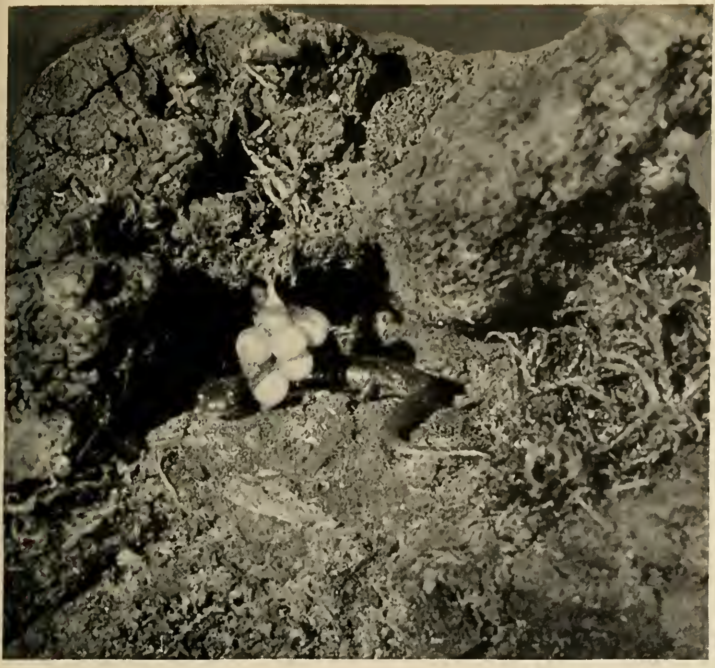
The Dusky Salamander



The eggs are laid on land, usually within a foot of the water, frequently under flat stones in the damp earth near a spring. The female (3½ inches long) stays with the eggs until they hatch, a period of two months

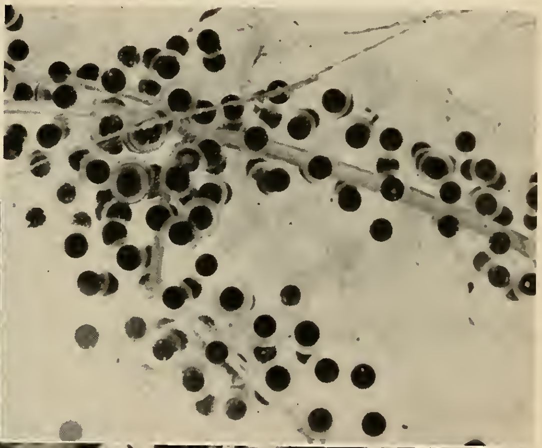


An egg cluster with forty-two closely constrained half-inch long larvæ, a day before they hatched

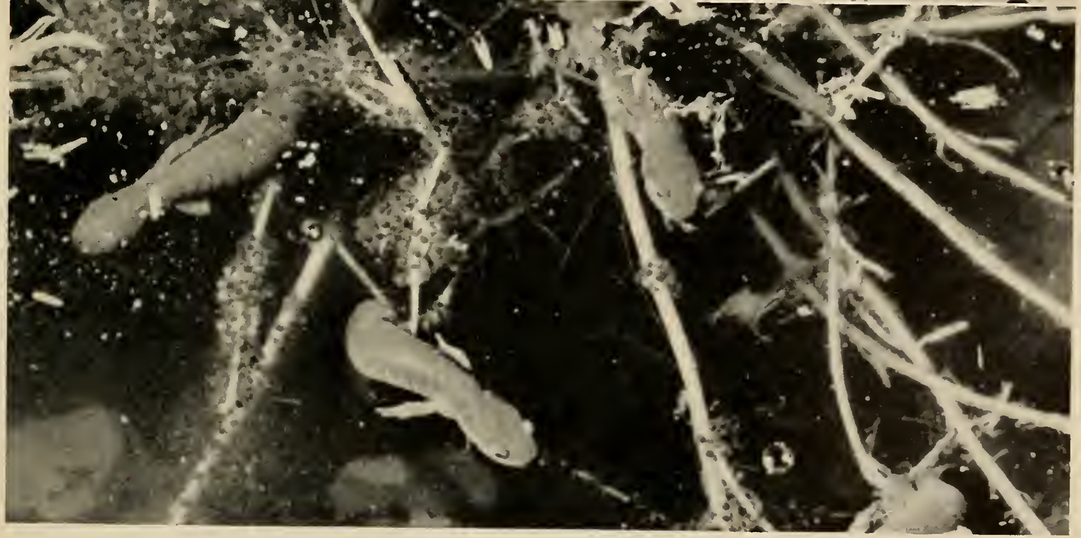


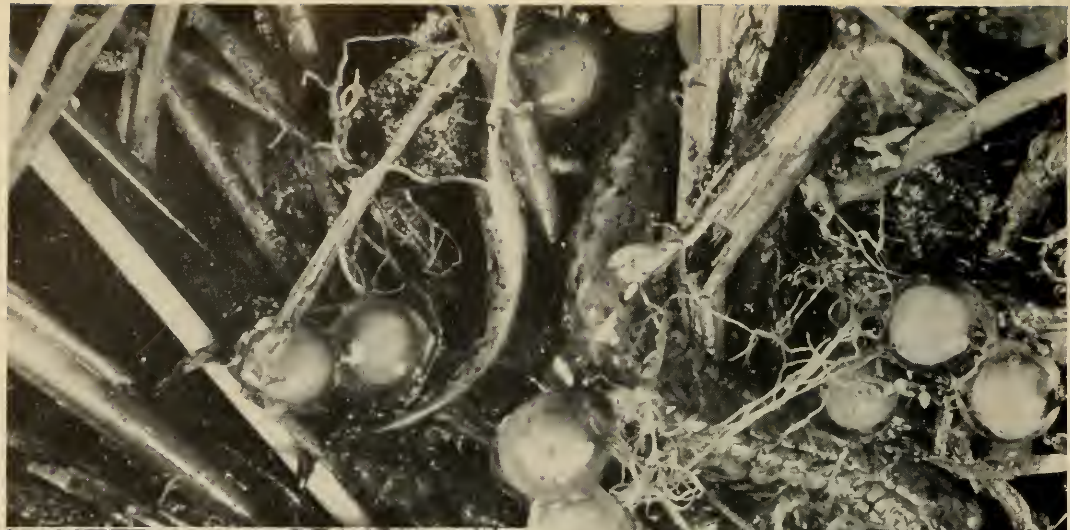
The red-backed salamander commonly lays her eggs in a cavity in a rotten log. She attaches them to the roof of the tiny chamber, the cluster usually taking the form of a bunch of grapes. (A detail from an exhibit in the American Museum)

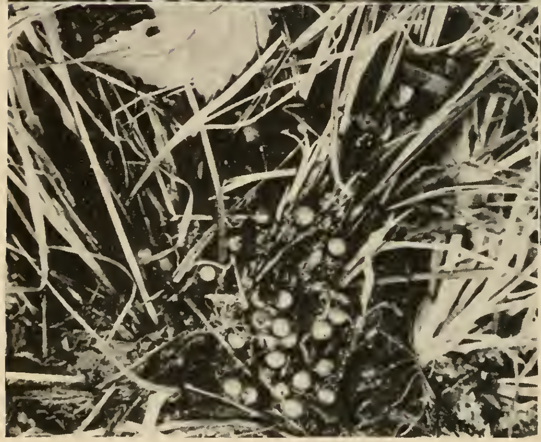
(Below) Hundreds of eggs of the Jefferson salamander may be found attached to the leaves of dead water plants



(Below) Here a group of female Jefferson salamanders are laying eggs in a woodland pond at night

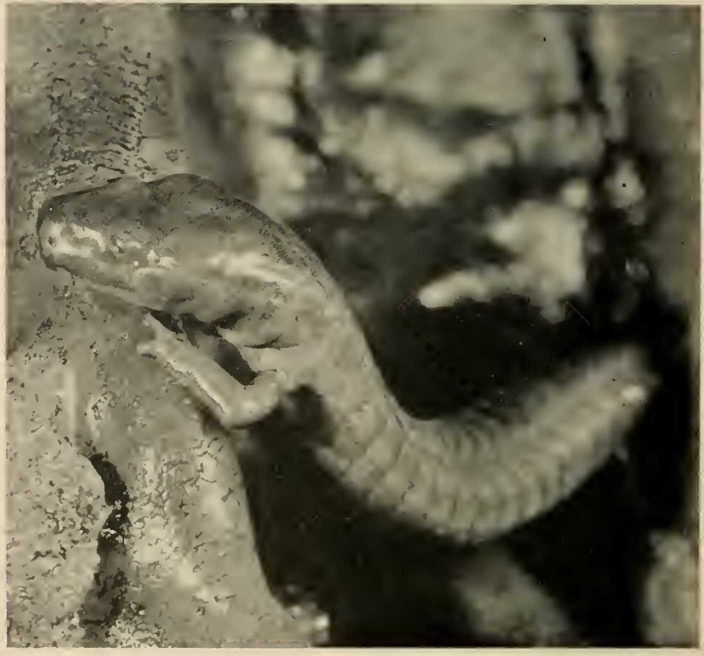






(Above) When this tuft of grass was pulled apart, a female four-toed salamander was discovered, surrounded by eggs

(Above) A typical egg mass exposed in a bunch of grass a few inches above water level



(Right) The blind cave salamander of the Ozark Mountains has shunned the light to such an extent that it has lost the use of its eyes

Among the more unusual modern salamanders is the stout-limbed hellbender, (shown top) a large, aquatic form found in mountain streams of the eastern United States. Although it reaches a length of eighteen inches, it is dwarfed by its Japanese relative, the giant Megalobatrachus, *the world's largest amphibian, which attains a length of at least four feet. This photograph and the one below showing the hellbender's egg mass, are from a group in the American Museum*

Science in the Field and in the Laboratory

Astronomy, Education, Appointments, Research, American Museum Activities

Edited by A. KATHERINE BERGER

Opening of the Hayden Planetarium

The opening of the Hayden Planetarium is now almost at hand. This eagerly awaited event, it is officially announced, will take place on October 1. On that day and thereafter the people of New York City will see the wonders of the heavens as only the new Zeiss Projection Planetarium can show them.

The unbelievably complicated projector, comprising in itself more than 120 stereopticons—which will throw upon the artificial dome of the sky stars and planets, sun and moon, comets and meteors—is nearly assembled and will be completely so by September 15.

Already the supplementary exhibits are being installed in this latest and most modern of astronomical museums. The curious and beautiful Aztec calendar stone of mosaic is in place. So also is the first of the astronomical photographs—a series of large, illuminated transparencies of celestial objects.

Several large meteorites, those fragments of stone and iron which hurtle to earth from outer space, have been moved to their new home from their former resting-place near the Seventy-seventh Street entrance to the Museum. Here was an engineering feat of no mean proportions, for the giant Ahnighito meteorite, brought by Peary from Greenland, weighs 36½ tons!

Soon will follow the rest of the meteorites; the collections of sun-dials, astrolabes, and astronomical paintings; and the Copernican Planetarium, that valuable adjunct of the Projection Planetarium, which presents dramatically in model form the principal members of the solar system. These and other attractions—for a general admission fee of 25 cents—will await the visitor on October 1.

Amateur Astronomers Association

The first meeting of the Amateur Astronomers Association for the years 1935-36 will be held on the evening of Wednesday, October 2, when Dr. Clyde Fisher will speak on "The Hayden Planetarium." This meeting will be held in the large auditorium of the American Museum of Natural History at 8:15 o'clock. Those interested are most cordially invited to attend.

The Junior Astronomy Club

With all regular activities suspended for the summer, the members of the Junior Astronomy Club have applied themselves in the observational branch of their science.

The first fall issue of the *Junior Astronomy News*, monthly club journal, will contain reports of observations made in and around New York City; and in addition will carry notes on the club's associate members who are scattered throughout forty-two states. Record of meteor showers and of the lunar eclipse of July 15 will form the major portion of the reports.

Club members are looking forward eagerly to the second edition of the *Handbook of the Heavens* which will be published in late September by Whittelsey House of McGraw-Hill.

Dr. Clyde Fisher, curator of astronomy and in charge of the new Hayden Planetarium, will address the club members at their first meeting in early November.

Lectures for teachers

The American Museum of Natural History will continue its coöperation with the colleges and universities this fall on an extended scale. Three free courses will be offered teachers in coöperation with the College of the City of New York, as follows:

Methods of Teaching Geography in an Activity Program, by Mrs. Grace F. Ramsey; Mechanics of Visual Instruction, by Mr. L. Wales Holden; Nature Study, by Miss Farida A. Wiley.

In addition to the above courses, City College will offer a pay course at the Museum, making extensive use of Museum materials and exhibits—Health Education: Recent Advances in Physiology, by Dr. G. Kingsley Noble.

Two free fall courses will be given in coöperation with Hunter College: Nature Study for City

Teachers, by Miss Farida A. Wiley; Mechanics of Visual Instruction, by Mr. L. Wales Holden.

Hunter College and N. Y. University will also offer pay courses at the Museum in Astronomy, by Dr. Clyde Fisher.

College or university credit will be allowed for all the above courses, as well as alertness credit by the Board of Education.

Annual Members of the Museum will be admitted without charge to any Museum courses that are free to teachers.

Education for the blind

On August 5 a group of twenty-five blind girls from the New York Institute for the Education of the Blind enjoyed a talk on the evolution of the boat, followed by a tour of some of the Museum halls, under Miss Newgarden. The girls, who were full of enthusiasm, greatly enjoyed "seeing" with their fingers various models of primitive craft, as well as actual, full-size canoes. Doctor Beebe's bathysphere and the great diving bell in the Hall of Ocean Life were carefully examined with fingers. The only disappointment in the visit seemed to be that Colonel Lindbergh's plane was hung too high to permit handling.

Visitors from abroad

On Thursday, June 27 Mr. Sievers and Mr. Saunders guided a group of eighteen German students and their American friends through the American Museum. This group was sponsored by the West Side YMCA and consisted of twelve boys and six girls, winners of the scholastic competition conducted by the German Government. The students averaged about seventeen years in age.

To Africa for wild life studies

Mrs. Mary L. Jobe Akeley sailed last June to visit the Transvaal and southern Rhodesia for the purpose of making a wild-life survey and to collect material for the American Museum. She also plans to visit Swaziland and Zululand, where she will make motion pictures of animal life and the ceremonials of primitive tribes.

She will organize her own safari and for the most part will travel alone and live in the open with a tent for shelter.

Appointment

Doctor Robert T. Hatt, a member of the American Museum staff since 1928, has resigned to become director of the Cranbrook Institute of Science, Bloomfield Hills, Michigan.

The Cranbrook Institute is one of a group of cultural institutions founded by Mr. George G. Booth, a short distance from Detroit. Associated and on adjacent campuses, covering a three-hundred acre tract, are Brookside School, Kingswood School, Cranbrook School, Christ Church, Cranbrook Institute of Science, and Cranbrook Academy of Art. The latter, of which the internationally known architect, Eliel Saarinen is chairman, consists of a museum and studios for both creative work and instruction. Here are eminent artists and craftsmen working in sculpture, ceramics, silver working, textile design and weaving, printing, binding, and other fields.

The Institute of Science, but five years old and the youngest organization in the group, has an excellent museum with exhibits in botany, zoölogy, ethnology, and mineralogy. A whole room is devoted to exhibits of luminescence in minerals, and is perhaps the best installation of its kind in the country. An astronomical observatory is equipped with a six-inch equatorial telescope used for research and instruction. The library is particularly well developed in the fields of the natural history of the Great Lakes region. A spacious auditorium, a small zoo, laboratories for research and educational purposes, and shops for construction round out the physical equipment. The staff of Cranbrook Institute is concerned with research, the development of the museum, and the conduct of classes in the natural sciences for the benefit of members of the Institute, pupils of the three Cranbrook schools, and the general public.

At the American Museum, Doctor Hatt has been occupied with researches and reports on the African mammal fauna, anatomical specializations in animals, and the life-histories of North American rodents. An expedition to investigate the cave faunas in the Sierra of Yucatan was conducted by Doctor and Mrs. Hatt and yielded much of unique interest concerning the past and present faunas of this little known region.

Summer research work at the American Museum

Dr. William K. Gregory and G. Miles Conrad have compiled charts depicting the phylogeny of several groups of teleost fishes, namely, the deep-sea fishes of the orders Isospondyli and Iniomi, the Pediculate, or angler-fishes, and the tropical Characin fishes. In connection with the studies on the Characins, an interlocking hinge was found between the two halves of the lower jaw in *Hydrocyon.* This hinge permits the widening of the mouth-gape horizontally as well as vertically. The development of this curious device has been studied in detail and comparisons made between it and the conditions in other Characins.

Dr. E. Grace White, of Wilson College, has completed three papers dealing with the Elasmobranch fishes (the sharks and rays). The first is entitled, "The Heart Valves of the Elasmobranch Fishes"; the second, "A Classification and Phylogeny of the Elasmobranch Fishes"; the third deals with "Some Transitional Elasmobranchs connecting the Catuloidea with the Carcharinoidea."

Frederick Shelden, of Rensselaer Polytechnic Institute, has been studying the musculature and osteology of the pelvic region in the Nematognathi, or catfishes, with a view to correlating the anatomy with the diverse uses to which the hind "limbs" are put.

Dr. William K. Gregory and Dr. Milo Hellman are studying the jaws and teeth of fossil anthropoids and man, a continuation of their work on the dentition of *Dryopithecus*, which was published in the *Anthropological Papers* of the American Museum in 1926.

Captain John R. Embich has been working on fossil fishes found in the Palæozoic beds of Pennsylvania.

Dr. David L. Poe has been making dissections of brains of various vertebrates in Mr. H. C. Raven's laboratory.

Miss Barbara E. Sims of Bryn Mawr College joined the group of summer students in Doctor Gregory's classroom on August 12. She will work on special problems under Doctor Gregory's direction.

To study ancient Peking man

Dr. George Pinkley, James Arthur research assistant of the department of comparative anatomy in the American Museum, having completed his work in the laboratory of Prof. J. L. Shellshear at the Medical College, University of Hong Kong, has now proceeded, accompanied by Mrs. Pinkley, to Peiping, where among other things he will have an opportunity to examine the brain cast and other remains of Peking man (*Sinanthropus pekinensis*).

The Dean Memorial Library

Dr. Bashford Dean, former curator of fishes in the American Museum, left to the department of ichthyology his invaluable collection of bound reprints of articles on fishes and all his books on ichthyology. He also bequeathed a sum of money, the income from which was to be devoted to the upkeep of this library. These books are housed in a room in the department of fishes, and this by the action of the Board of Trustees in 1925 is set apart as the Bashford Dean Research Room in Ichthyology.

To Dr. E. W. Gudger, as bibliographer in ichthyology, there come great numbers of fish reprints for his card catalogue continuing the published *Bibliography of Fishes*. These are checked up, sorted, bound, and added to the Dean Library. Thus this library has quite doubled in size in the past ten years.

Miss Margaret Storey of Stanford University has from time to time during the past three years worked on this library under Doctor Gudger's direction, and she has just spent most of the month of July on these books. Bookplates have been put in, numbers painted on the backs, the covers have been treated with a leather preservative, and all the books have been shifted and space left for the additions to each series.

She has prepared for the binder 28 volumes of reprints, and also 2 volumes of reviews of Volume III of the *Bibliography of Fishes* and of letters of congratulation received when the various volumes were published. She has also selected and prepared for mailing to scientific men and particularly to ichthyologists a large collection of reprints of Doctor Dean's articles sent by Mrs. Dean for that purpose.

The Book Shop

The policy for the sale of books at the American Museum has been changed. Besides books by Museum authors, there will be others by authors of good standing on subjects allied to Museum interests. Particular attention is being paid to children's books.

Lists of books will be issued at regular intervals which the shop will send upon request. Books will be sent by mail, the charge for postage being additional. For information, apply to the Book Shop at the American Museum.

Honors

Dr. Barnum Brown, curator of fossil reptiles at the American Museum, has been elected a Fellow of the Royal Geographical Society at London, England, in recognition of his contributions to palæontological, geographical, and archæological science.

Dr. E. W. Gudger, bibliographer and associate curator in the department of fishes, American Museum, was officially elected to a life membership in the North Carolina Academy of Science at its 1935 annual meeting in Greensboro, "in recognition of many years of active service with a spirit of loyalty to the Academy and the State." Doctor Gudger has been a member of the Academy for twenty-nine years.

Reviews of New Books

Psychology, Birds, Fishes, Reptiles, Animal Pets, Plants, Exploration

THE REPTILES OF CHINA. *By Clifford H. Pope. Vol. X, Natural History of Central Asia. American Museum of Natural History. Set in type by G. P. Putnam's Sons, N. Y. 1935.*

THE REPTILES OF CHINA by Clifford H. Pope has just been issued by the American Museum. It represents Volume X of the Natural History of Central Asia. Volumes I, II, and IV have already been published, while the manuscript for two more volumes are in hand. This series of quarto volumes will represent the final reports on the extensive surveys and large collections secured by the Central Asiatic Expeditions under the leadership of Dr. Roy Chapman Andrews.

Preliminary reports on the reptiles secured by the expedition have been published from time to time. The present volume represents a comprehensive and critical treatment of all the known snakes, turtles, and crocodilians from China, together with an annotated check list of the lizards. Mr. Pope was a member of the expedition from 1921 to 1926. More recently he visited the principal museums in this country and abroad with a view to straightening out the confused relationships of some of the species. The present volume brings together the observations he made in the field and in the museums, and correlates these data with the previously published information on the reptiles of China.

The 130 species and subspecies of snakes, 22 turtles, and 1 crocodilian considered are described and figured. A summary of their distribution and habits is presented. Critical remarks on the material examined or previously described are given for most of the forms. At the close of the section dealing with the snakes a series of tables is presented summarizing the information available on the habitat preferences, feeding habits, breeding habits, sexual dimorphism, and variation in dentition of the various species. Students of Chinese herpetology will also appreciate the appended list of species known from the various provinces of China. Since keys to the genera and species are both numerous and complete, the volume will remain not only an exhaustive treatise on the herpetology of China but a handy reference book for the quick identification of any Chinese reptiles which may come to hand. Unfortunately, a similar, up-to-date source book does not exist for the herpetology of America.—G. K. N.

MANUAL OF THE SOUTHEASTERN FLORA. *By John Kunkel Small, Ph.D. Published by the Author, New York Botanical Garden, New York City. 1933.*

DR. SMALL, who was for so many years head curator of herbariums at the New York Botanical Garden, has entirely rewritten his extensive *Flora of the Southeastern United States*, which after going through two editions has become quite rare.

This new work consists of descriptions of the seed plants growing naturally in Florida, Alabama, Mississippi, Eastern Louisiana, Tennessee, North Carolina, South Carolina, and Georgia, and will be welcomed by all students of the flowering plants of this section of the United States.

Doctor Small has gone over this field most thoroughly, for he is a rare combination of indefatigable field naturalist and herbarium research student. He knows the plants of the southeastern states better than any living person. In fact his books have been the outstanding authority since the days of Chapman.

There is no other volume which attempts to describe systematically all of the flowering plants of this region. Its completeness will be a great satisfaction to any student who is trying to become familiar with the plants. And I have always liked Doctor Small's dichotomous keys, that is, keys which call for decision between only two points or steps at a time.

The book is copiously illustrated by excellent line-drawings. With the exception of those of the grasses, and of the sedges of the genus *Carex*, the drawings have been made by Miss Mary E. Eaton. In order to facilitate the tracing and determination of genera and species, a drawing showing a flower and a fruit of the first species under each genus is given.

This *Manual* is the result of thirty-five years' study of the systematic botany of the Southeastern States, more than two decades of which were interspersed with intensive field work.

As a companion volume to this one we may look forward to an exhaustive treatise on the seed plants of the Southern States west of the Mississippi. The forthcoming work, which is well along toward completion, will be titled *Manual of the South Central Flora.*—CLYDE FISHER

THE HAWKS OF NORTH AMERICA. *Their Field Identification and Feeding Habits. By John Bichard May. The National Association of Audubon Societies. New York. 1935. $1.25.*

SINCE Dr. A. K. Fisher's classical report on "The Hawks and Owls of the United States in their Relation to Agriculture" (Bulletin 3, U. S. Department of Agriculture, Division of Ornithology and Mammalogy, 1893), there has been no comprehensive work devoted to North American hawks and their economic significance.

Beginning long before the date of Doctor Fisher's work, there has been an ever increasing persecution of the birds of this family in this country. Part of this, no doubt, has been due to some ignorance of the economic status of hawks in general; part, to some inability to distinguish the various species which might, at least at times, be justly condemned, or to a disinclination to restrict punitive measures to such individuals as might be caught in their depredations; and part, to some complete indifference on the matter so long as the birds furnished interesting targets for the gun.

In any event, the numbers of these birds are fast decreasing, and if Doctor May's timely volume proves to be of service in stimuating public interest in their preservation, it will have served a useful purpose. If such preservation is not effected, it may not be long before the public must needs depend on books of this sort and on museums of natural history for a knowledge of the appearance and habits of many of the hawks, for they will be so depleted in numbers that a sight of them in life will be an infrequent event.

The modest price at which this volume is sold must not be taken as a criterion of its merits. Aside from its value as an economic study, the book supplies a convenient means for the identification of the hawks of North America north of the Mexican boundary but including Lower California. Thirty-seven fine plates in color by Allan Brooks show the various species in different plumages, and four plates in black-and-white by Roger Tory Peterson delineate the characteristic pattern and outline of the different birds as seen overhead in flight. The text supplies descriptions of each of the geographical races, or subspecies, only one of which is illustrated on the plates, with a statement of the range of each. There is a map for each of the species (except a few casual visitors) showing the breeding range (or both present and former breeding ranges), and the winter distribution where this is different.

There is a general discussion of the habits of each species as a whole and of its food, with a table giving the results of examinations of many stomachs and crops. Lists of the various vernacular names are helpful in view of much confusion in the application of such terms as "hen hawk," "pigeon hawk," and other such names. Unfortunately, there is no general index, but the table of contents and the list of plates each occupy but a single page, making it not difficult to find the account or colored figure of any species when its accepted name is known. If it is desired to find one for which only the name "hen hawk," for example, is known to the reader, a rather long search through the text will be necessary.

Appendix I gives a short summary of the various state laws relating to hawks, and Appendix II contains a good reference bibliography on the subject matter of the volume.

Doctor May's book should be in the hands of all persons interested in hawks as well as in those of hunters and conservationists who should be interested in these fast-disappearing birds.—J.T.Z.

WILD BIRDS AT HOME. *By Francis Hobart Herrick. D. Appleton-Century Co. New York. 1935. 8vo. xxiv, 345 pp. Many inserted half-tones.*

OLIVE Thorne Miller was among the first intensive students of the home life of wild birds in America. She had no blind or "hide-up," as English ornithologists call it, but she had a camp chair, patience, and a sympathetic interest in the ways of birds. Burroughs had no liking for this type of contact with birds. "Bird reporting," he called it, which is just what it is. To him a bird was a field companion to be lived with and enjoyed, but not to be systematically and persistently spied on.

Mrs. Miller's period of greatest activity was the decade from 1885 to 1895. At the beginning of the succeeding century Professor Herrick placed this type of bird study on a more scientific basis in his *Home Life of Wild Birds* (1902). One of the few ornithologists of this period who was also a trained biologist, his work was of much value to the bird "observer" or "watcher" whose sole training was a love of birds and a speaking acquaintance with his local species.

In this book Professor Herrick made effective use of the camera, then but lately added to the ornithologists' equipment, and somewhat shocked the "bird hunter with a camera," to whom the photograph was an end in itself, by bringing the nest to the camera instead of overcoming the difficulties imposed by the situation in which the bird had placed it and, like a good sport, photographing it *in situ*.

But the liberties that Professor Herrick took with a nest and its contents without disturbing their owners was part of his story.

In this new book all these methods of photography are brought up to date, and we are told *what* to observe as well as *how* to observe. Direct instructions are followed by actual demonstrations in detailed biographies of numbers of familiar species, and there are also chapters on "Birds'

Nests," "Life and Instincts," etc. In short, here is an indispensable book for one who would study the ways of wild birds at home.—F. M. C.

THE BACK-YARD ZOO. *By Daniel Pratt Mannix, Coward-McCann, Inc., New York, 265 pages, $2.*

THERE are many "Back-Yard Zoos" in this country. Natural history museums throughout the land are constantly bombarded with questions from far and wide: "What shall I feed a baby skunk," "How shall I care for a bear cub," or "Please send complete instructions for the care and feeding of katydids!"

If Mr. Mannix's book enjoys the wide circulation it deserves, there will doubtless be many additional "zoos" of this type. Numbered among his pets were skunks, porcupines, fish, crows, armadillos, opossums, Gila monsters, and raccoons. A note in the front of the book says that the stories "have been written simply to amuse. They are not meant to be scientifically correct and should not be read as zoölogical treatises." Nevertheless, Mr. Mannix has succeeded very well indeed in following a truthful picture as he proceeds to enlarge upon the activities of his fellow conspirators.

It is clear from the book that the various animals caused uneasy moments to more than one person, particularly armadillos. These "armor-plated" residents of Texas wandered into a neighbor's yard one morning and proceeded to disturb the garden soil slightly, much to the agitation of the gardener. However, when it was discovered that the animals had been eating Japanese beetles and other noxious insects, they were eventually given the run of the garden, and Mr. Mannix was invited to place them in his friend's greenhouse for the winter.

Children and their parents alike will enjoy the friendly and straightforward method employed throughout the book to relate various stories and to tell clearly of the adventures of the principal characters.

It is very evident that the creatures were well cared for, and that the author took no chances with the welfare of his pets. He relates one incident that shows this very conclusively. In giving his Gila monster some water, Mr. Mannix first warmed the ice water in a paper cup with his hands before permitting the lizard to enjoy it.

All of these articles were originally published in the *St. Nicholas Magazine*, and we can only hope that we shall see more material of this type.

—W. H. C.

THE EMPIRE OF THE SNAKES. *By F. G. Carnochan and H. C. Adamson. F. A. Stokes Company, New York City.*

THERE are a few authentic records of people who have partly immunized themselves against the venom of poisonous snakes by taking intentionally or otherwise, small quantities of the poison into their systems. Fred Carnochan, while a member of the Smithsonian-Chrysler Expedition to Tanganyika, was thrown in contact with a tribe of African natives who seem to practise immunization on a large scale. This is not so much to avoid the dangers of snake bite as to give prestige to the immunized. A very elaborate culture has been built up around the ceremonies of immunization. The essential ingredients in the treatment appear to be the ground dried heads of boomslangs, cobras, puff adders, and mambas, which, when mixed with lion fat, are rubbed into a series of slashes made in the skin. Carnochan himself took the treatment, which is by no means painless. Its efficacy must be judged from the variety of hazardous incidents which Carnochan reports.

Carnochan became so much interested in these natives who could apparently handle poisonous snakes with impunity that he returned to Africa to learn more of their secrets. The greater part of the book which has been brought together from Carnochan's notes by Mr. Adamson, deals with the lives of the African natives as Carnochan learned to know them during this period. We read of a plant which, when ground up and painted on the skin, renders it as "tough as the hide of a giraffe." When applied to the skin "not even the sharp teeth of the mamba can go through it." Carnochan is a a trained observer who on all his expeditions studies and collects plant and animal life intelligently. On this expedition he became particularly interested in the drugs which could be made from native plants. Once he made a "voluntary visit to the realm of living dead" when he imbibed a paralyzing drug made from the root of an unknown plant.

Carnochan's experiences with flowers that kill fish, stones that detect lies, and plants that prevent death from cobra bite are dramatically recorded against a background of everyday life among the Wanyamwesi. There is the romance of his kitchen boy, the beliefs and superstitions of the natives, the death of the great-granddaughter of the Emperor of the Snakes. The book is one that tells a very realistic story of African native life. It is one which will provoke further observation and study of the snake poisons and native drugs of Africa.—G. K. N.

THE TARAHUMARA, AN INDIAN TRIBE OF NORTHERN MEXICO. *By Wendell C. Bennett and Robert M. Zingg. Chicago, University of Chicago Press. Publications in Anthropology, Ethnological Series. 412 pages, illus. $4.00*

THIS compact volume, by two of America's youngest and most competent research anthropologists, is primarily a reference work for specialists. As such it contains a wealth of carefully checked material (gathered in the field) divided into two sections. In the First Part Doctor Zingg (research associate in anthropology in the University of Chicago) describes the Material Culture of the Tarahumara. Painstakingly but without imagination he tells us how these Indians live and under what physical conditions; what domestic animals they use; what foods they eat and how their crops are raised. There are chapters on primitive industries (lumbering, woodwork, weaving), on housekeeping, costume and handicraft. A long account of the animals and plants of the region is more an essay in taxonomy than the integrated ecological study it might have been.

Doctor Bennett (an associate curator in anthropology at the American Museum of Natural History) carries the story on through the social life of this interesting tribe of some 40,000 living members. He gives us a mass of information on economics, government, law and property concepts; on the family, religion, education, sports, fiestas; on marriage, death, and native philosophy. A chapter on "peyote," favorite drug of the Tarahumara Indians, is tantalizingly brief and suggests again to this reviewer what a stirring book could be written on Pharmacy, Ancient and Modern.

The volume concludes with an excellent terminal essay which attempts to generalize from the detailed data and to construct a rounded-out picture of the Tarahumara. Incidentally, a "Summary Table of Classified Tarahumara Traits" provides a model which may well be followed by all research ethnologists; and the excellent schematic analysis of the Sonoran Uto-Aztecan Culture amply proves with what care the authors planned, and carried out, their exacting labors.

The general reader, however, will be disappointed and inclined to lay the book aside as another "can't-see-the-forest-for-the-trees" affair. This will be a pity, for the authors cannot reasonably be blamed for failing to do what was probably not their intention. Nevertheless, it is unfortunate that such rich material was not organized more effectively, with less attention to minutiæ (which can never be completely exhausted in any case) and a more balanced regard for the subject as a whole. Perhaps the authors, with this conscientious research job safely "on the record," will soon show us—each in his own way—how Anthropology can be induced to dance as well as plod: and without sacrifice of either dignity or authority.

—Harold Ward

Men Against the Clouds. *By Richard L. Burdsall and Arthur B. Emmons, 3rd. Harper & Brothers, N. Y. 292 pp., $3.50.*

Suppose you found yourself alone on a remote Tibetan mountain with both your hands and your feet frozen, watching your two comrades disappear in the enshrouding clouds as they push on for the last 1500 feet to the tip of a five-mile high peak, with an excellent chance of never seeing them again—what would be your thoughts and sensations?

Of this and similar situations is the thrilling account of the Sikong Expedition in *Men Against the Clouds* by Richard L. Burdsall and Arthur B. Emmons, 3rd. It is the amazing story of four young Americans—three of them still in college—who undertook to climb the mighty Minya Konka, the holy snow-clad peak which stands between the Red Basin of Szechwan in Western China and the high Tibetan grasslands beyond.

For centuries in almost complete obscurity, shrouded with mystery, the towering Minya Konka is the highest peak ever scaled by an American expedition, and the second highest ever conquered.

Few white men had ever gazed upon its breathtaking heights. Their accounts are meager indeed. In 1879 the expedition of Count Bela Szechenyi, from a distance of thirty-five miles, estimated the height of the Minya Konka to be 24,934 feet. Subsequent maps, however, either omitted the mountain entirely or located it incorrectly, giving no altitude. In 1929 Dr. Joseph F. Rock, of the National Geographic Society, reached the foot of the peak and computed it to be 25,600 feet. Theodore and Kermit Roosevelt skirted the vicinity of the peak in 1930 and estimated the height as possibly 30,000 feet.

Careful barometric measurements by the Sikong Expedition set the altitude definitely at 24,891 feet.

Traversing almost two thousand miles of China before they reached the Sino-Tibetan border and the foothills of the Minya Konka, these four adventurers scorned the elaborate preparations for successive high altitude camps, communications, and specially chosen native bearers which mark the organization of a conservative high mountain scaling expedition. All of them experienced mountain climbers, with enviable achievements already to their credit, they matched sheer determination and daring against awful nature—and won!

The book is profusely illustrated with numerous photograps, maps and charts made by members of the expedition, together with valuable appendices on big game hunting, mountaineering, and surveying.

It has been my pleasure to meet three of the members of the Sikong Expedition. They are quiet, unassuming fellows; yet their achievement stands as one of the most daring ventures of modern times.

With a background of several years of travel in China and Tibet, I can personally recommend *Men Against the Clouds* as more than a thrilling book of travel and high adventure—it is an important contribution to the field of exploration.

—Harrison Forman

THE STORY OF AN AFRICAN CHIEF. *By Prince Nyabongo, Charles Scribner's Sons. New York. $3.00.*

THIS book deals with the customs of an important Uganda tribe, and recounts the attempts of the white man to impose a "Western civilization" upon these enlightened, happy, well-ruled, and honorable people.

Ten years before the birth of Chief Ati's son, on the night of the Feast of the New Moon the drums proclaim the advent of a white man—Stanley in search of Livingstone. Ati, intrigued by Stanley's knowledge, asks him to send him men who can read Stanley's book (the Bible) as well as make guns. After the coming of Catholic, Protestant and Moslem missionaries and an attendant religious war involving all the natives of the region, Chief Ati concludes that his old tribal religion is good enough.

Ati's son by the finest of his 375 wives, and whom his father wishes to name for Stanley, is refused Christian baptism by the Reverend Mr. Hubert because Ati "is living in Sin." Later it is difficult for the Chief to reconcile this attitude with the Story of Solomon read to him from the Bible. The boy, at the age of two, known by the native name Mujungu, begins his education under the best native tutors. When Mujungu is twelve, Reverend Mr. Hubert asks the chief to send him to the mission to pursue an elementary training. This school, unfortunately, strives to eliminate everything of native origin, to punish the lad for his freedom of thought and to leave his inquiring mind unsatisfied.

After Mujungu's graduation from a private school—he has been expelled from the Mission for writing a letter to the young woman he expects to marry—smallpox breaks out and Ati falls sick. Mujungu heroically takes charge, summoning a German doctor from Tanganyika and being vaccinated and inducing all his people to do likewise. Again the drums telegraph for medical assistance from Mombasa and Zanzibar. The ready response of these medical men is in pleasing contrast to the refusal of near-by missionaries to aid the stricken tribe. Ati succumbs to the plague and Mujungu is invested by the King as Chief. He now devotes himself utterly to his people.

The Story of an African Chief is more than an interesting tale. Due to its fictional form it is a highly appealing narrative. It is illuminated by adage and fable. Reading between the lines, Prince Nyabongo and Mujungu are obviously one. In the modest recounting of his deeds of intelligence and bravery, in his struggle to learn the truth, there is a sincere plea for the preservation of the best in the ancient Buganda civilization and against the inculcation of Western ideas unless adaptable to an enlightened people whose origins of culture are in a remote past.

Prince Nyabongo, student and friend of Professor William Lyon Phelps at Yale, is now at Oxford. His book is one in which all lovers of Africa, as well as readers in general, will find delight.—MARY L. JOBE AKELEY

Recent American Museum Publications

NOVITATES

No. 796. Distributional and Phylogenetic Studies on Indian Fossil Mammals. — I. American Museum Collecting Localities in Northern India. By Edwin H. Colbert.

No. 797. Distributional and Phylogenetic Studies on Indian Fossil Mammals. — II. The Correlation of the Siwaliks of India as inferred by the Migrations of *Hipparion* and *Equus*. By Edwin H. Colbert.

No. 798. Distributional and Phylogenetic Studies on Indian Fossil Mammals.—III. A Classification of the Chalicotherioidea. By Edwin H. Colbert.

No. 799. Distributional and Phylogenetic Studies on Indian Fossil Mammals. — IV. The Phylogeny of the Indian Suidae and the Origin of the Hippopotamidae. By Edwin H. Colbert.

No. 800. Distributional and Phylogenetic Studies on Indian Fossil Mammals. — V. The Classification and the Phylogeny of the Giraffidae. By Edwin H. Colbert.

No. 801. Results of the Archbold Expeditions. No. 1. A New Genus and Species of Squirrel from Celebes. By R. Archbold and G. H. H. Tate.

No. 802. Results of the Archbold Expeditions. No. 2. Twelve Apparently New Forms of *Rattus* from the Indo-Australian Region. By G. H. H. Tate and Richard Archbold.

No. 803. Results of the Archbold Expeditions. No. 3. Twelve apparently New Forms of Muridae (other than *Rattus*) from the Indo-Australian Region. By G. H. H. Tate and Richard Archbold.

No. 804. Results of the Archbold Expeditions. No. 4. An Apparently New Race of Wallabies from Southern New Guinea. By G. H. H. Tate and Richard Archbold.

No. 805. New American Spiders with Notes on other Species. By W. J. Gertsch.

No. 806. New American Asilidae (Diptera). — IV. By C. H. Curran.

No. 807. The Tahitian Black Marlin; or Silver Marlin Swordfish. By J. T. Nichols and F. R. La-Monte.

No. 808. Parasitic Bees of the Genus *Coelioxys* from the Belgian Congo. By T. D. A. Cockerell.

No. 809. Bees from Eritrea, Northwest Africa. By T. D. A. Cockerell.

No. 810. Results of the Archbold Expeditions. No. 5. Seven Apparently New Forms of Phalangeridae from the New Guinea Region. By G. H. H. Tate and Richard Archbold.

No. 811. An almost totally Ambicolorate Halibut, *Hippoglossus hippoglossus,* with partially Rotated Eye and Hooked Dorsal Fin—the only Recorded Specimen. By E. W. Gudger and Frank E. Firth.

No. 812. New American Diptera. By C. H. Curran.

No. 813. New Asilidae from the Southwestern United States (Diptera). By A. Earl Pritchard.

No. 814. Results of the Archbold Expeditions. No. 6. Twenty-Four Apparently Undescribed Birds from New Guinea and the D'Entrecasteaux Archipelago. By Ernst Mayr and A. L. Rand.

BULLETIN

Volume LXVIII, Art. 5. The Taxonomy of the Genera of Neotropical Hystricoid Rodents. By G. H. H. Tate.

Recently Elected Members

A report from the membership department lists the following persons who have been elected members of the American Museum:

Patron

Mr. Robert W. Johnson

Fellow

Mr. Orlando F. Weber, Jr.

Honorary Life Members

Messrs. Harry F. Beers, F. D. Duke, Henry J. Langham, George N. Pindar.

Sustaining Members

Mrs. Anna E. Kresge

Messrs. William W. Fleming, Joseph Glass.

Annual Members

Mesdames G. S. Achilles, Matthew Andrews, V. Blanchard, Samuel J. Carpenter, Emily Fearhake, H. D. Haight, S. Peters Holmes, John Quincy Hunsicker, Malcolm S. Mackay, Endicott Peabody, Herbert N. Straus, Sheldon Whitehouse.

Sister Lapierre.

Misses Mary T. Cockcroft, Minnie A. Daly, Mary Findlay, Mary E. Hart, Martha Hird, Elvine L. Neeser, Lou Rogers.

Doctors Alex. A. Allen, August F. Bauer, George Evans, Maurice Finkelman, Jacob Kaufmann.

Messrs. Albert Farwell Bemis, Hugh Brooks, Randolph Bullock, Don Burdick, Harry E. Byram, John E. Chibas, Charles L. Couard, James Crosby, Eugene Eisenmann, Robert D. Elder, J. W. Farley, William B. Goodwin, Bernard Halfond, Preston J. Jennings, Felix W. Knauth, Halstead Lindsley, Frederick William Ockert, John Olyphant, John G. Rolph, Theodore I. Schneider, Joseph Simola, Jr., Frederick H. Stoye, Sheldon Whitehouse, Charles T. Wilson.

Associate Members

Mesdames J. Walter Allen, L. S. Allison.

Daniel Bacon, Bagster-Collins, Geoffrey Bare, Willette Spragg Barker, Charles T. Bartlett, Laura Dolbear Beach, Thomas H. Beck, Herman Benkema, Hattie Voss Beringer, Alfred K. Biggs, James E. Blythe, J. Mora Boyle, Horace R. Boynton, Rose Swain Brown.

Stanley P. Chase, E. Whittredge Clark, A. S. Cobb, T. A. Curtis.

Elizabeth G. Dadisman, J. de Chadenedes, D. W. Dennis.

Hedwig H. Ernst.

Jessie Benedict Faye, E. J. Feisel, Jr., Richard T. Fisher, John Taintor Foote, Madeline Clarke Foreman, George D. Forrest.

Annie E. Gardner, W. D. Gregory.

Meredith Hare, I. B. Harris, E. F. Helling, Robert B. Henderson, Alice Herriott, George R. Hill, Alice M. Hooks, George S. Huntington.

B. A. Jackson.

Beatrice S. Kitchen, Sadie B. Knox.

Ambrose Lansing, Rosamond N. Lefebvre, Raymond Lewis, Liane Limpus, George G. Lockwood.

J. W. Magruder, Reyburn McClellan, Howard I. Michaels, C. P. Moss.

Martha J. Neubauer, Isabel M. Newell.

Rena M. O'Connor.

J. G. Pearsall, E. S. Pennell.

Marian Robinson.

Frances P. St. Clair, Phoebe D. Schwarz, T. L. Sharp, Mary W. Sheffert, Robert T. Shellenberger, Mary Hunter Sicha, W. W. Silk, Harry R. Sinclair, Anthony Sini, D. P. Sullivan.

C. A. Taylor.

N. S. V. Underhill.

James N. Van Devanter.

Carolyne Hyde Woodin.

Misses Margaret W. Alexander, Louise Allen, Dorothy Allers-Ferre, Marie Anneberg, Julia A. Arnold, Joan Avery, Fannie B. Ayers.

Della L. Baker, M. Alberta Banks, Agnes C. Barrett, Mary Beckett, Isabelle K. Beinert, Margaret Bishop, D. A. Boardman, Sophie N. Boatwright, Alice K. Bowen, Grace Carmen Braem, Bernice L. Bursley, Mary P. Burtsell.

Emma M. Cain, Nora Carmody, Carrie L. Chapin, Frances H. Clark, Victoria Clyne, Susan de L. F. Cooper, Elsie M. Cox, R. Margaret Crabb, Marie B. Cremer, Caroline C. Cresson.

Kate Daum, Mary E. S. Davidson, Alice C. Dean, Jessie E. Dow, Della C. Downing, Stephanie Dukoff, Ethel C. Dunlap, Amy C. Duryee.

Sylvia H. Evans, Jr., Edna E. Ewald.

Erma E. Foster, Norma Foster, Joanna Aitken Fowler.

Gail Gartz, Dorothy Gatton, Susan Gregg Gibson, Agnes Gifford, Alice J. Griffin, Eugenie V. Griffin, Helen M. Grimmell.

Josephine V. Hall, Kate N. Haney, Elisabeth Harris, Marian Huckins, Melba F. Hurd, Nancy Isabel Hutton, Evangeline Hymer.

Mabel M. Johns.

Elsie M. Kliber, Elsbeth Kroeber.

Annie B. Law, Mary E. Lewis, Lillian Lipsky, May Lloyd, Isabel Luxon.

Josephine T. Mainster, Edith C. Mason, Lila McNutt, Mildred Meeker, Rachel Mirsky, Edith Mortensen, Gladys A. Munro.

Joann E. Owens.

Elizabeth Paine, Anita M. Peterson, Callie Pitts, Maggie Purnell.

Emma Reutemann, Florence S. Roberts, Amy S. Roe.

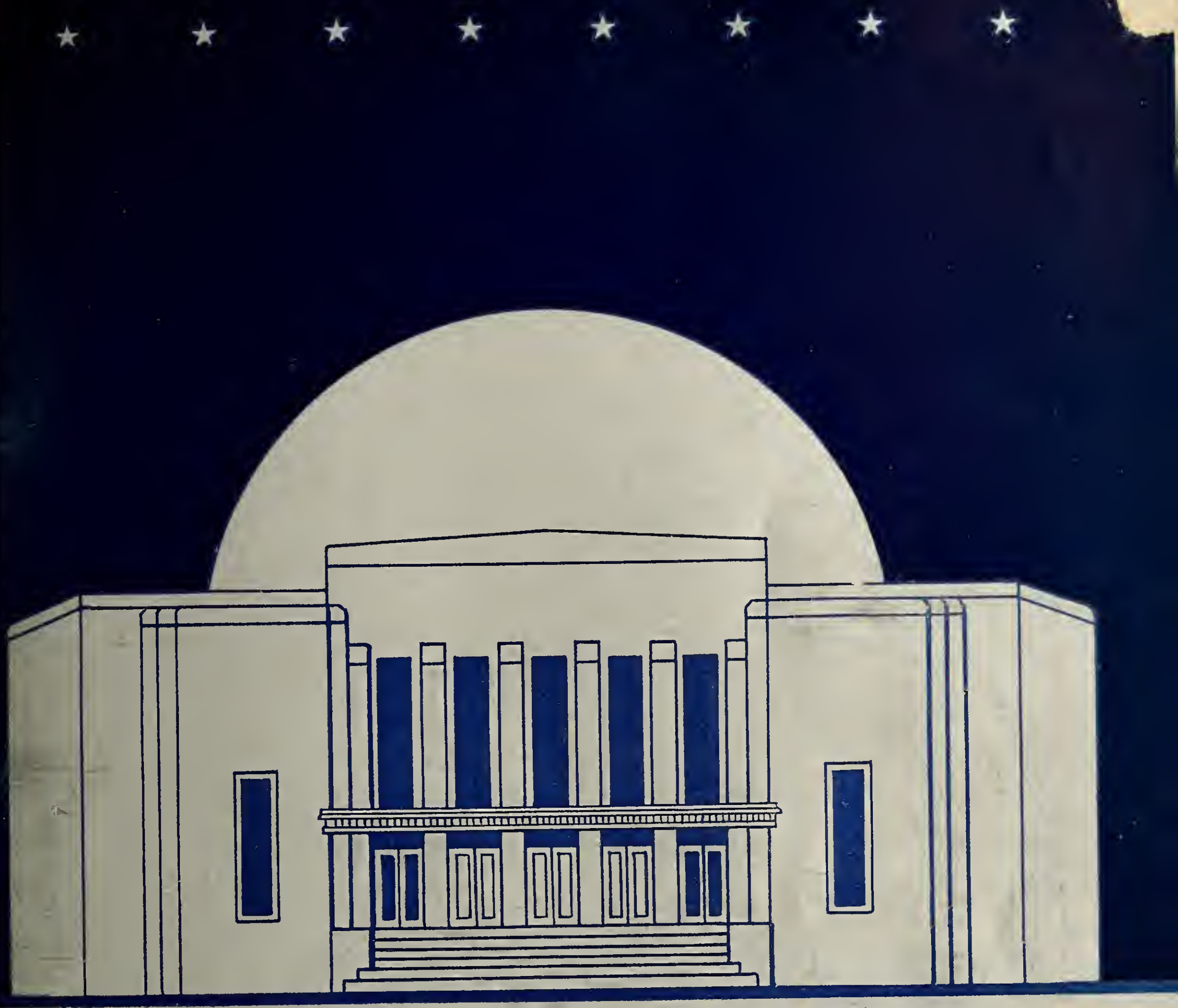
Minnie Schwartz, Bertha C. Schwenger, Romaine Sessions, Minnie M. Shannon, Edna Corning Smith, Emma Estelle Pulley Smith, Susie B. Smyth, Josephine Sullivan.

Virginia Tear, Martha R. Thompson, Katharine Tobin, Jean C. Tompkins.

Alice Leman Webb, Elisabeth B. Wells, Anselma Wiehl, Marie H. Wilby.

Laura A. Zimmerley.

Reverends Arthur F. McKenny, Henry K. Pasma.



NATURAL HISTORY

URNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

FIFTY CENTS OCTOBER 1935

Museum Animal Theatres

ANIMAL THEATRES reproduced from the lifelike exhibits in the Museum —four of these fascinating theatres to be set up which will prove a delight to every boy and girl possessing them. It will be an absorbing work to cut out and arrange these theatres—hours of anticipation. What a supreme delight would these have been to the young people in Little Women! The animals may be moved about and no paste is necessary. It is a natural history exhibit that can be staged in any home. The backgrounds are taken from the exhibits in the Museum and the animals modeled on those seen in the groups.

Sold only in sets of four for $1.00
Including postage, east of Chicago $1.14
Including postage, west of Chicago, including all of U. S. possessions $1.32

No. 1 represents the African Lion [*Felis leo*]. It is a scene on the edge of the mysterious veldt near Nairobi, British East Africa. The king of beasts is waiting, with his family, under a tree for the dusk to descend prior to their sally for their evening meal.

No. 2 represents the Bengal Tiger [*Felis tigris*] in the Kheri forest in India. The tigress leads her cubs to the stream to drink and through the reeds and trees appears the lordly male. This represents one of the groups collected for the American Museum by the Vernay-Faunthorpe Expedition.

No. 3 is the Gorilla [*Gorilla savagei*]. Here we see the Lake Kivu region of the Belgian Congo with the slope of Mt. Mikena showing in the purple sunset. This great animal was carefully studied by Carl E. Ackley on his many trips to Africa and from this theatre one will glean many interesting facts about a creature that has long been too little known.

No. 4 is the African Elephant [*Elephas africanus*]. The world's largest game animal is seen in a beautiful setting near Lake Paradise, British East Africa. The group is dispersing to cover after having been startled and the great bull wheels about to charge the enemy.

Each theatre when set up measures 18″ wide, 10″ high and 8″ deep. Maps and descriptive material accompany each set. Because of their artistic colors, these animal groups make unusual decorations in the home as well as being splendidly adapted for class room use and above all for the playroom of every child. Parcel post charges additional. The weight packed for transportation is 3 lbs.

Address all orders to
THE BOOK SHOP, THE AMERICAN MUSEUM OF NATURAL HISTORY
77th Street and Central Park West, New York City

NATURAL HISTORY

The Journal of the American Museum of Natural History

VOLUME XXXVI ★ ★ ★ ★ OCTOBER 1935

An Impression of The Hayden Planetarium .... *Cover*

From a drawing by George F. Mason

Charles Hayden .... *Frontispiece*

Foreword .... F. Trubee Davison 187

The Hayden Planetarium 188

The Story of an Actual Trip Through an Astronomical Wonderland

Exploring in Space 195

A Photographic Series Depicting the Spectacular Beauty of the Heavens

Problems of Construction .... Wayne M. Faunce 207

Interesting Engineering Problems Overcome in Building The Hayden Planetarium

Astronomical Fiction .... Frank C. Jordan 217

Amusing Errors in Astronomy to be Found in Literature, both Ancient and Modern

The Birth of the Solar System .... Clyde Fisher 220

Facts and Theories that Attempt to Explain How the Earth and Other Astronomical Bodies Were Formed

Ancient Man and His Universe .... Marian Lockwood 229

Ingenious Conceptions Held by Many Ancient People Concerning the Universe

Glimpses Into Relativity .... Clyde Fisher 235

A Non-mathematical Consideration of Certain More or Less Obvious Relations of the Einstein Theory of Relativity

The Calendar Through the Ages .... Frederick Slocum 247

Complications in the Recording of Time that Have Beset Man from Ancient Times to the Present

Cosmic Rays .... W. F. G. Swann 255

A Discussion of the Various Theories Concerning the Origin and Behavior of the Cosmic Rays

The Mysterious Moon .... Dorothy A. Bennett 262

Separated from the Earth by 240,000 Miles, the Moon Yields its Secrets to the Astronomer

Science in the Field and in the Laboratory 266

Current Events in the World of Natural History

Reviews of New Books 271

Recent Publications for Those Interested in Nature

Publication Office: 246 Meadow Street, New Haven, Conn.

Editorial: Edward M. Weyer, Jr., Editor; A. Katherine Berger, Associate Editor; Dorothy L. Edwards.

Manuscripts should be sent to the Editor, The American Museum of Natural History, New York, N. Y.

Subscriptions: Natural History is sent to all members of the American Museum as one of the privileges of membership. Membership Manager, Charles J. O'Connor.

Advertising: Tom Davin, Manager of Publications, The American Museum of Natural History.

Copyright, 1935, by The American Museum of Natural History, New York, N. Y.

Champlain, N. Y.

CHARLES HAYDEN

Donor of the Planetarium instruments, and in whose honor the Planetarium is named

★ ★ ★ ★ ★ ★ ★

There is, in my opinion, no finer way of expressing the splendid influence the Hayden Planetarium will have on the spiritual and educational life of the community in the years to come than Mr. Hayden's own words when he announced his magnificent gift:

"I believe that the Planetarium is not only an interesting and instructive thing but that it should give a more lively and sincere appreciation of the magnitude of the universe and of the belief that a much greater Power than man must be responsible for the wonderful things which are daily occurring in the universe.

"I hope that the Planetarium when completed will give many people that view of life."

F. Trubee Davison

★ ★ ★ ★ ★ ★ ★

The Hayden Planetarium

The story of an actual trip through an astronomical wonderland, where the stars are brought indoors, and the heavens themselves come closer

THE Hayden Planetarium is one of the most recent additions to the American Museum of Natural History. This unusual project was made possible by a loan from the Reconstruction Finance Corporation, while the planetarium instruments were the gift of Mr. Charles Hayden, for whom the planetarium is named. The red brick edifice with its copper dome stands on the northeast section of the Museum grounds, facing Eighty-first Street near Central Park West.

The modest-looking building is more than it appears to be on the outside, for here we have not a building only, but a veritable treasure-house of the stars, a theatre of sky magic where the heavens hang low and clear, and rainy nights are things unknown. Here, on any day of the week, and any month of the year, afternoon or evening, come the multitudes of those who are eager to see clear skies above them, that they may be able to trace, away from the fog and smoke of the city, the patterns of the stars against the blue of night. Here, too, come those who wish to learn more about the stars, those great suns—and the planets—near neighbors of the earth—and the numerous other interesting things that are to be found in the sky.

A super "magic lantern"

Let us visit first the very heart of the planetarium building—the great domed hall on the second floor where the stars "perform." As we enter this room, we are immediately conscious of its size—a size greatly augmented by the stretch of the dome some forty-eight feet above our heads. One of the first things we notice is the peculiarly shaped instrument which stands in the center of the room—a mechanism resembling a giant dumb-bell, about twelve feet long. This bizarre-appearing "creature" is the projection instrument which throws upon the white background of the dome—as upon an artificial sky—the images of the stars and other heavenly bodies. It is in reality a collection of more than 120 stereopticon lanterns—a super "magic lantern." The lantern slides are irregular in shape but the images they throw fit closely together, with no gaps between, and the projection instrument throws upon the artificial sky the spots of light representing the stars. The large globes at either end of the "dumb-bell" are connected by a rod, upon which the whole instrument pivots, so that any particular set of stereopticons—those presenting the stars of the northern hemisphere, say, or the Milky Way—can be turned upon the sky.

The stars come out

Now that we have had an opportunity to look around a bit in the light, let us sit down and wait for night to come. There are many others under this great dome (the room holds 742 people) who are as eager as we for the stars to come out. Suddenly music begins to play; a sense of expectancy hushes the room. A lecturer steps unobtrusively into the speaker's desk at the north end of the room, he waits for a moment, and then gradually, as he stands there waiting, night falls. The walls and chairs and ceiling of what was a moment ago a great room disappear, and we find ourselves outdoors —in Central Park, surrounded by the New York City skyline—with the darkening heavens above us. It is night, and suddenly, taking our breath with their beauty, the stars come out.

There they are above us, shining in their accustomed places, arranged in the constellations which to many of us are old and familiar, and to many others new and unfamiliar—a brand-new world which many are just entering. An involuntary gasp of amazement rises from the audience—for this surely is no planetarium, no "show"—this is the sky above us, with the real stars shining down.

A journey through the heavens

Soft music still plays on. The lecturer begins to speak. The music dies away. "Now that evening has come," he says, "and such a clear and cloudless evening—perhaps you would like to hear for a while about the stars." Then, with his electric pointer as our guide, we enter into that other world of the sky—we refresh our memories of the star names and groupings, we see the moon rise and the planets pass across the pattern of the stars; we see the heavens wheel above us. But more than this—we come to understand, perhaps for the first time clearly, why the moon appears sometimes as a crescent, and sometimes as a great disk of light; we understand what makes the planets "wander"; why the stars pass nightly over our heads; we see for the first time a comet journeying away from the sun with its tail before its head.

Our forty minutes under the stars have been filled with interest and beauty, and after all too short a time the voice from the speaker's desk warns us that the night is over and it is almost dawn. In the east gradually appears the flush of light which precedes the sun, and then, quickly, precipitately, from beyond the horizon comes the sun "driving night before him." It is day.

As we pass the speaker's desk, we hear him explaining that with this wonderful instrument, standing so grotesquely and clearly revealed now in the daylight, one can move time backward or forward. By this he means that it is possible to show the heavens as they appeared thousands of years ago or as they will appear 12,000 years from now, for instance, when Vega will have become our pole star instead of Polaris. Many are the potentialities of this great instrument, but it is impossible to put it through all its paces in one brief period of forty minutes. We shall come again to see a shower of meteors, that marvelous and awe-inspiring sight which so few of us will ever see outside this building. We shall come to gaze, wide-eyed, at the northern lights which we so seldom see in these latitudes. We shall come again, and then again, for here we shall find the ever-changing and dramatic panorama of the heavens.

The Copernican Planetarium

And now let us descend to the first floor where we shall find that other instrument which so splendidly and adequately complements the Zeiss projection planetarium—the great Copernican planetarium placed on the ceiling of the first floor chamber. This is in reality a glorified orrery, forty feet in diameter, with a lighted bulb in the center to represent the sun, and with globes representing the six planets nearest the sun revolving around that body at their relative speeds. Not all of the satellites are included, as the orbits of some of those of Jupiter and Saturn are, because of unavoidable discrepancies in the scale of the model, so distant from their primaries that some of the satellites would have become entangled with each other. While the Zeiss Planetarium on the second floor shows the heavens as they appear from the earth, the Copernican Planetarium on the first floor shows the other half of the picture, the solar system to which our earth belongs, more or less as it would appear if we could observe it from out in space.

After we have watched for a few moments the planets and their moons as they revolve about the sun, we happen to glance at the floor of the room. There we notice a beautiful design inlaid in colored terrazzo, and circular in shape. This is an exact replica of the famous Aztec Calendar Stone, the calendar device of those early Mexican astronomical pioneers. Labels on the pillars of the hall explain the ancient and beautiful symbolism of the Stone.

The blue walls of this circular room are decorated with figures of the zodiacal constellations taken from an early work on astronomy, Bayer's historic *Uranometria,* published in 1603. The stars of the constellations are of luminous silver paint, standing out realistically against the blue background.

Interesting exhibits

Now let us examine the ambulatories or halls of the building which we shall find filled with interesting objects. We shall find that to those who were well acquainted with the American Museum before the days of the Hayden Planetarium, many of these astronomical objects are old friends. We notice the great meteorites, Ahnighito and Willamette, with the many smaller irons which were formerly in the Museum foyer. This collection of meteorites is probably not excelled by any other in the world.

We rediscover with pleasure the three beautiful paintings of solar eclipses by the late Howard Russell Butler. These are placed over one of the main entrances to the projection planetarium chamber—the entrance opposite the door leading from the Roosevelt Memorial Building. We find on the walls of the ambulatories, also, Mr. Butler's other astronomical paintings—which were formerly in the Pro-Astronomic Hall in the Museum. We note especially the two paintings of Mars as seen respectively from its two moons, the exquisite painting of the Aurora Borealis, and the striking colored panels of the solar prominences.

We notice also the Museum loan collections of sundials, astrolabes, compasses, and hourglasses. One case before which we stop contains two accurate replicas of Galileo's telescopes, the first telescopes to be used astronomically.

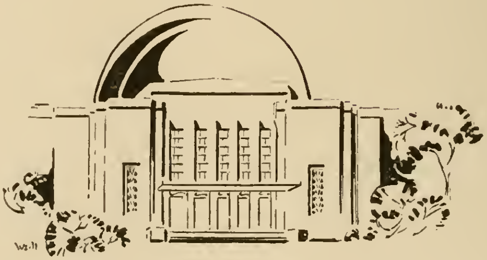
Notable among the new furnishings of the building are the large transparencies—fifty in all—which decorate the walls of both ambulatories. These photographs on ground glass are placed in cases in the walls and lighted from behind, giving a luminous appearance especially appropriate to astronomical phenomena. Here we find represented the finest astronomical photographs in the world—planets, comets, sun, moon, nebulæ, star clouds, star clusters, etc.

Opposite the main entrance to the building, on the first floor, is an interesting group of paintings, a triptych showing outstanding features of American Indian astronomical mythology. In these murals by Mr. Charles R. Knight we discover the typical Indian Thunder Bird; the great Arch of the Aurora, upon which dance the White Indians of the North; the Old Man creating the earth from the mud under the sea; and many other figures from American Indian mythology.

The old and the new

As we leave this wonderful building, we carry with us a last impression of the twelve photo-murals on the walls of the foyer opening on Eighty-first Street. These murals, like those in the Copernican Chamber, are reproductions of the constellation figures in Bayer's *Uranometria.* Quaint and beautiful in design, the Rabbit, the Big Bear, the Little Bear, the Swan, and the other mythological figures from the sixteenth century gaze out at our twentieth-century crowds coming to view one of the most modern of all modern devices. And they, as well as the Planetarium itself, attest the eternal wonder which man has found in the starry skies.

—Marian Lockwood



Wurts Bros.

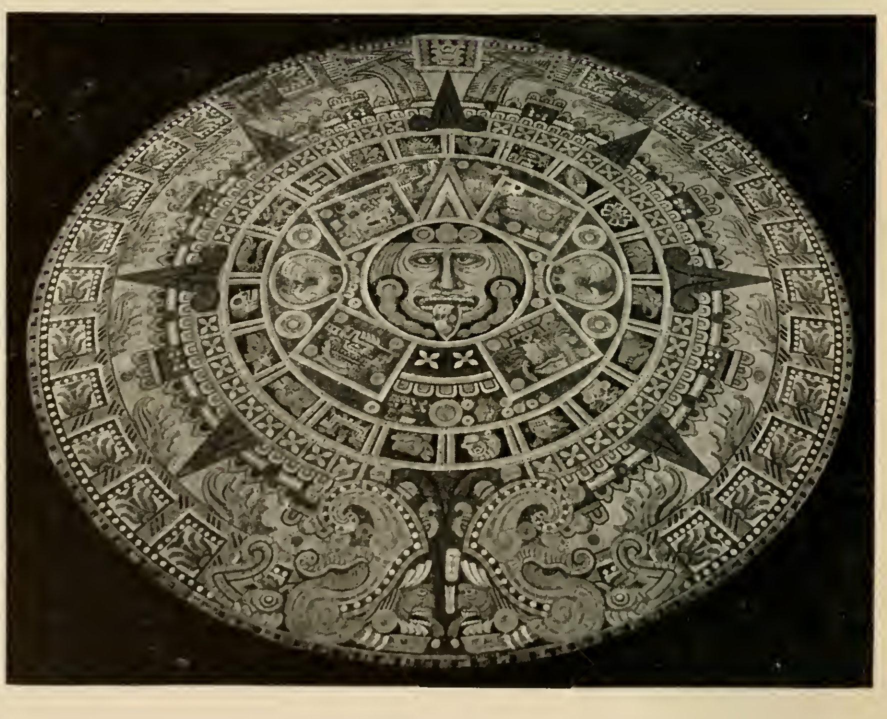
THE EAST STAIRWAY

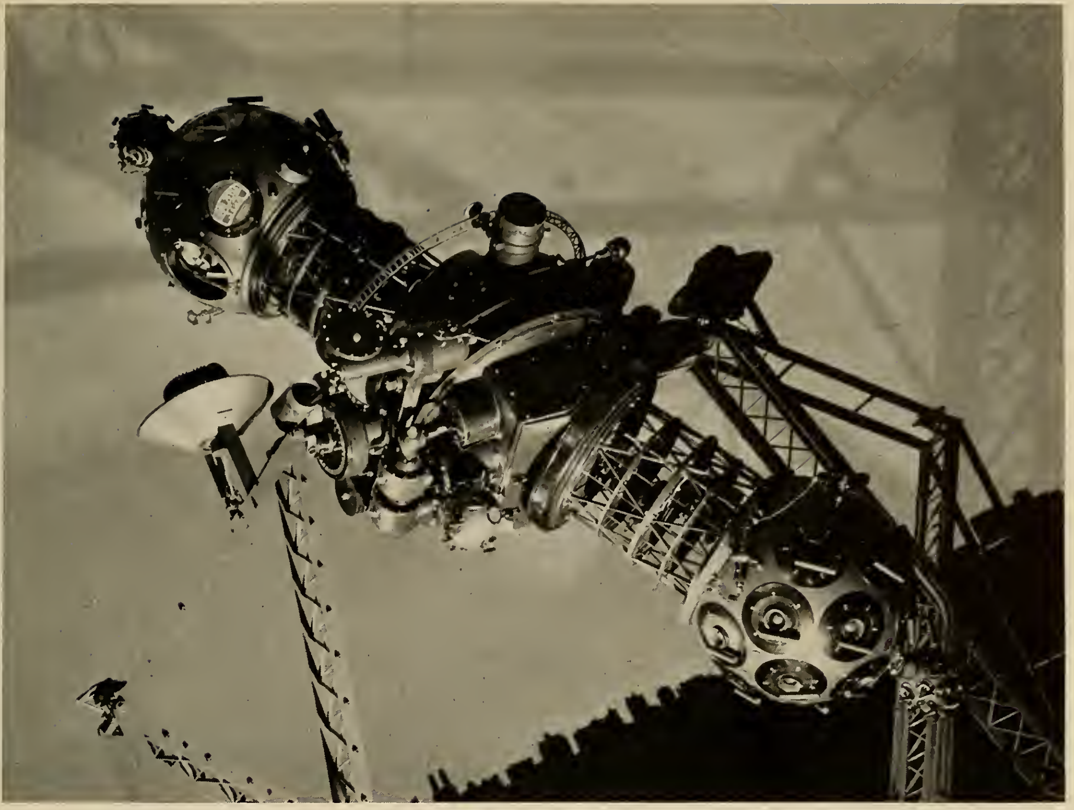
As one stands on the landing of the east stairway one sees, below, the first-floor ambulatory and the entrance to the Copernican Chamber which contains the model of the solar system in motion. Just outside the entrance to this room stands the Willamette Meteorite, the largest meteorite so far found in the United States. The stairway above leads to the entrance to the Projection Chamber

(Left) This photograph shows, in their Planetarium setting, the famous triptych of eclipse paintings by Mr. Howard Russell Butler

Wurts Bros.

(Below) The Calendar Stone, famous monument of the Aztecs, was doubtless connected with the worship of the sun. It records many Aztec creation myths as well as divisions of the year, day signs, and points of the compass

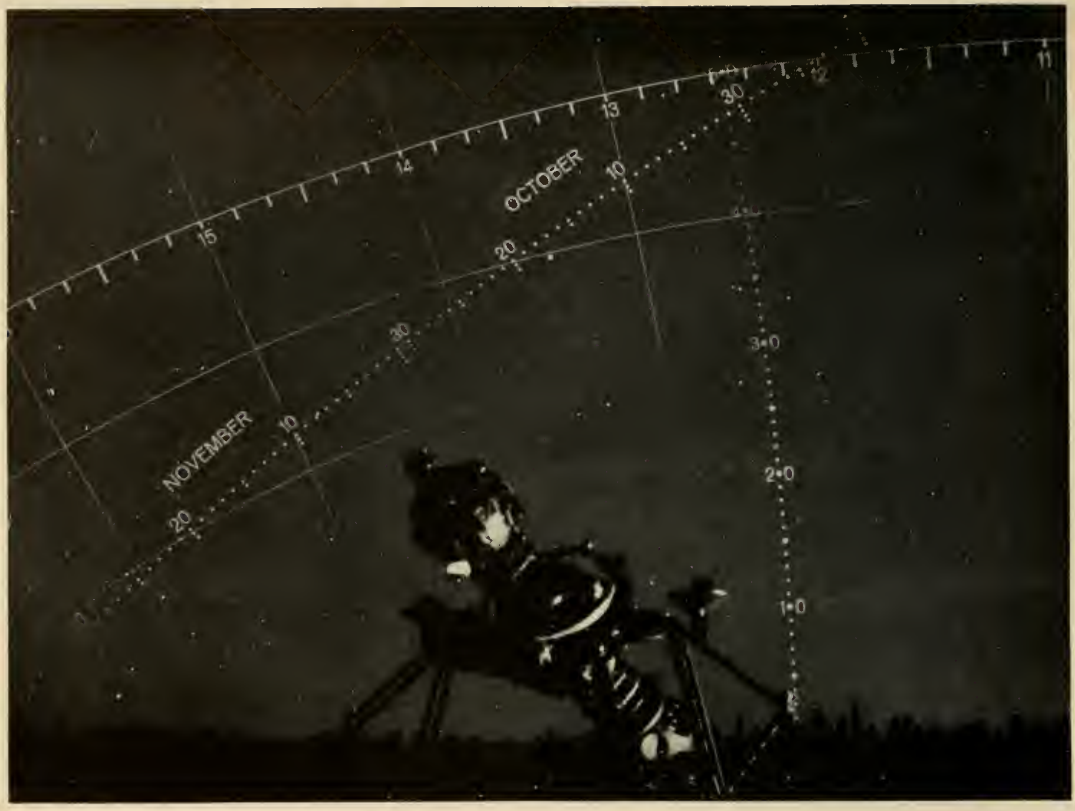




Wurts Bros.

Rising against the skyline-silhouette of New York City, this modern "Aladdin's Lamp" brings the stars indoors. Comprising in its grotesque form more than 120 stereopticon machines, the giant apparatus turns and twists, throwing aloft on the dome the images of thousands of celestial bodies

The switchboard controlling the projection instrument—a complicated affair. On the level "desk-top" are the switches which turn the stars on and off. On the vertical part of the board are the rheostats controlling the brightness of the stars and other celestial objects



Wurts Bros.

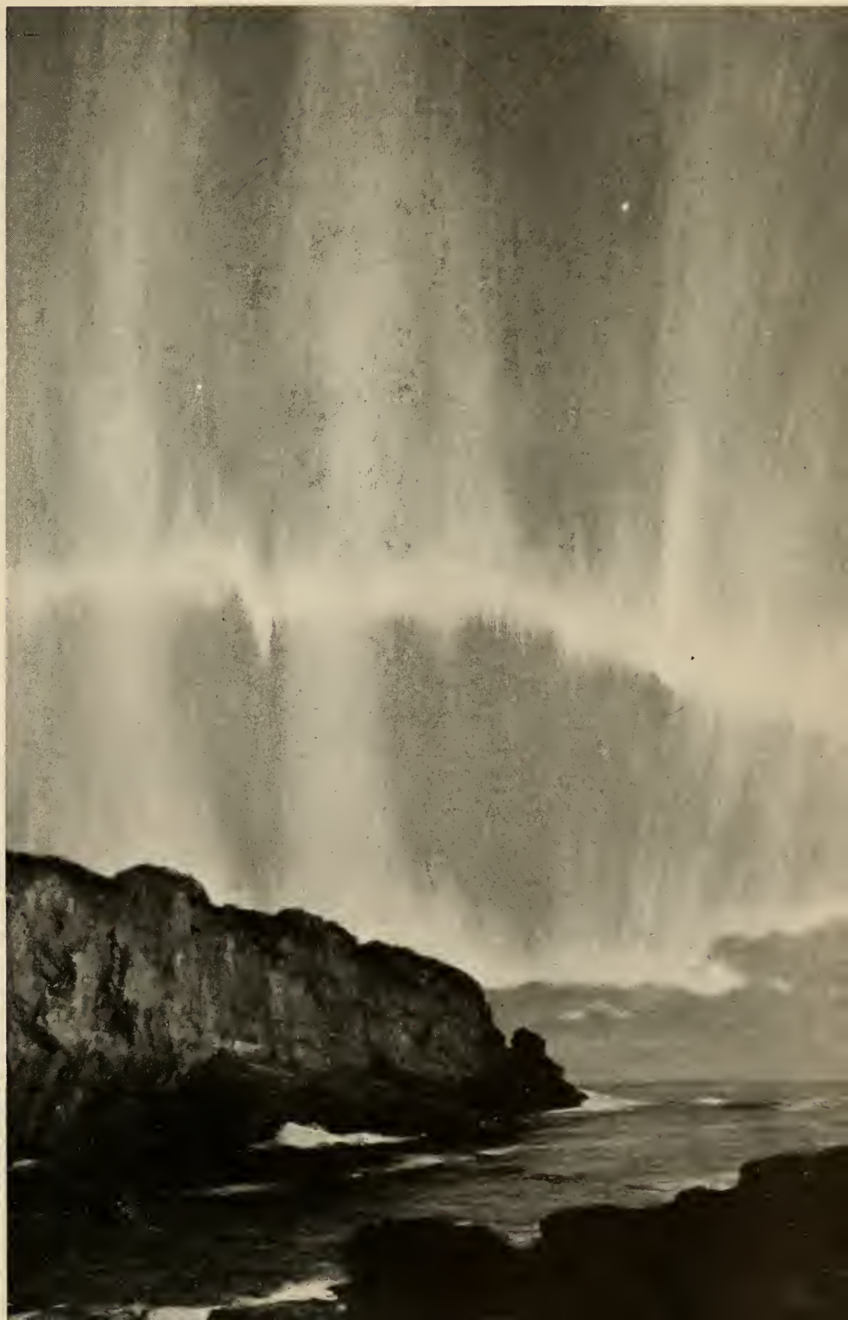
Night has come to the Planetarium Chamber, darkening the sky as the sun sinks below the horizon. The stars come out, shining with a clear and beautiful light above the towers of New York. *Suddenly, against the sky, are projected the celestial circles—always so difficult to visualize—the celestial equator, the ecliptic, the meridian—as well as their relations to each other*

An audience enthralled. A group of youngsters whose faces show plainly what they think of the Planetarium "show." No boredom here!

Exploring in Space

In the following series of pictures the reader is invited to take an imaginary 10,000,000,000,000,000,000-mile trip which will include in its ports of call the Sun, Moon, and Mars in the Solar System; Star Clusters and Nebulæ in the Galaxy, and a side trip to an Island Universe, returning on a Meteor Trail. Traveling at the speed of light (186,000 miles per second), the entire trip, not including stop-overs, could be completed in sixteen hundred millennia

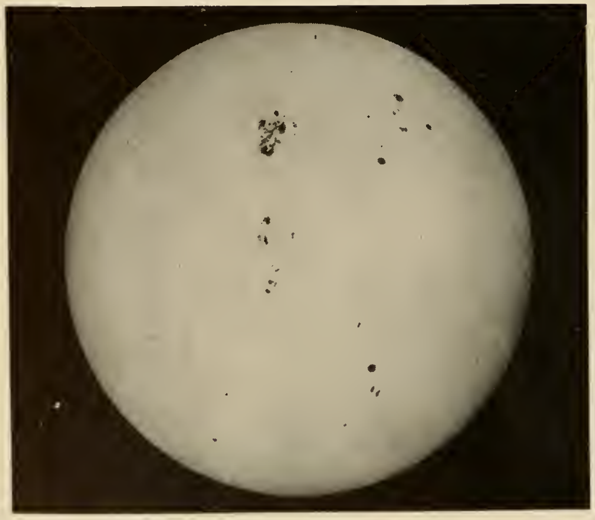
Legends
by
Dorothy A. Bennett



Aurora Borealis. These swaying streamers of the Northern Lights, painted as the artist saw them on the coast of Maine in August, 1919, are evidence of electric activity in the earth's upper atmosphere. A beautiful phenomenon correlated with the sun spots, the aurora follows the eleven-year cycle of the solar disturbances

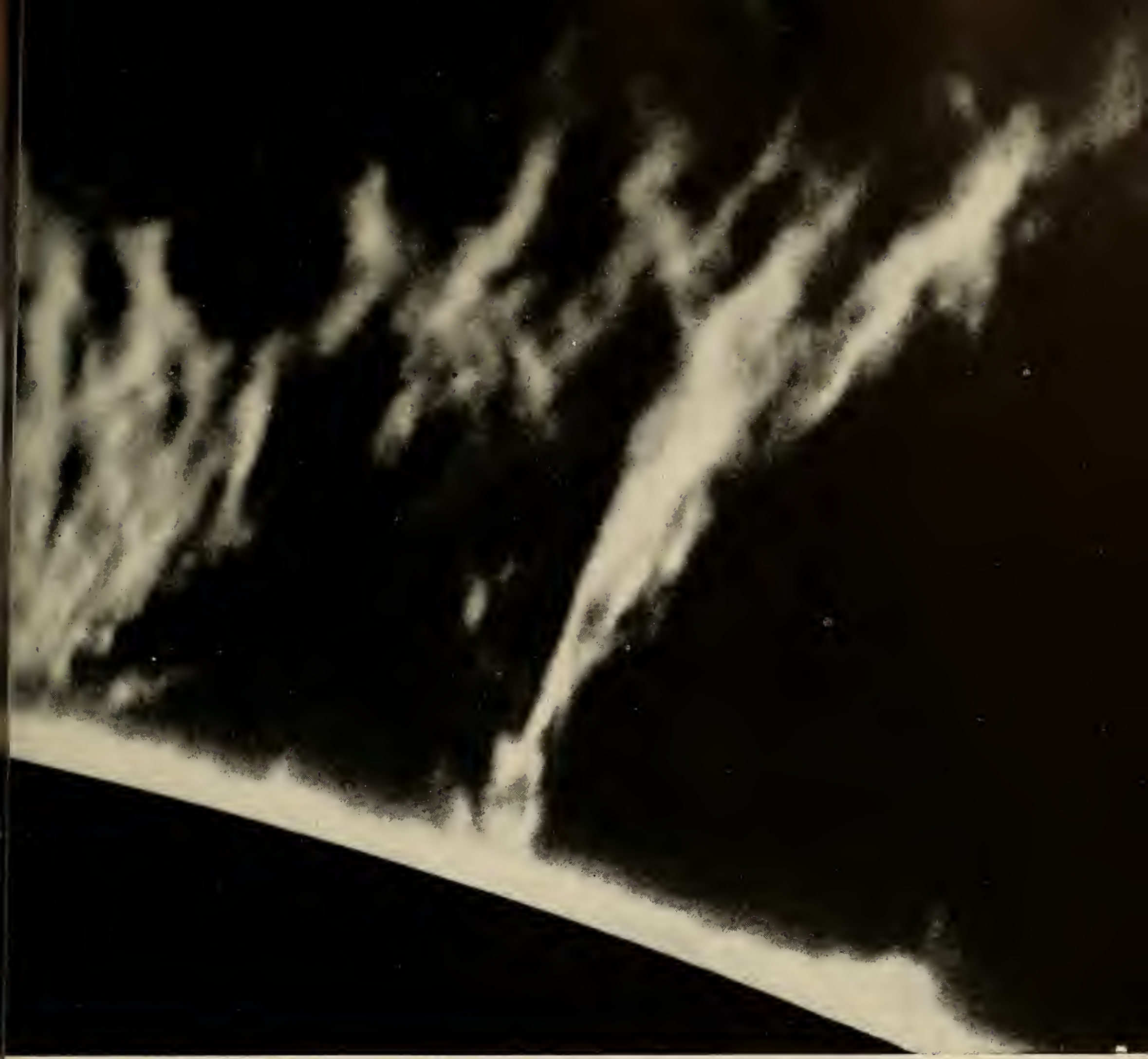
From a Painting by Howard Russell Butler

Yerkes Observatory



(Above) Solar prominences. From the seething surface of the sun escape hydrogen, helium, and calcium in rose-red prominences that rise thousands of miles. Until lately only observed at the infrequent times of eclipse, they can now be studied on any clear day with the spectrohelioscope

(Left) The sun's disc. The black spots on the sun's surface are giant whirlpools of magnetic activity. Small in comparison with the greater sun, they are larger than the earth. Cool in contrast to their hotter background, they appear black even though white-hot



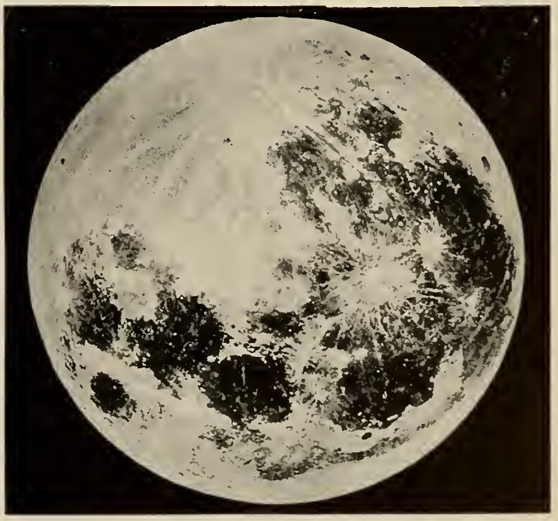
Mt. Wilson Observatory

Sun

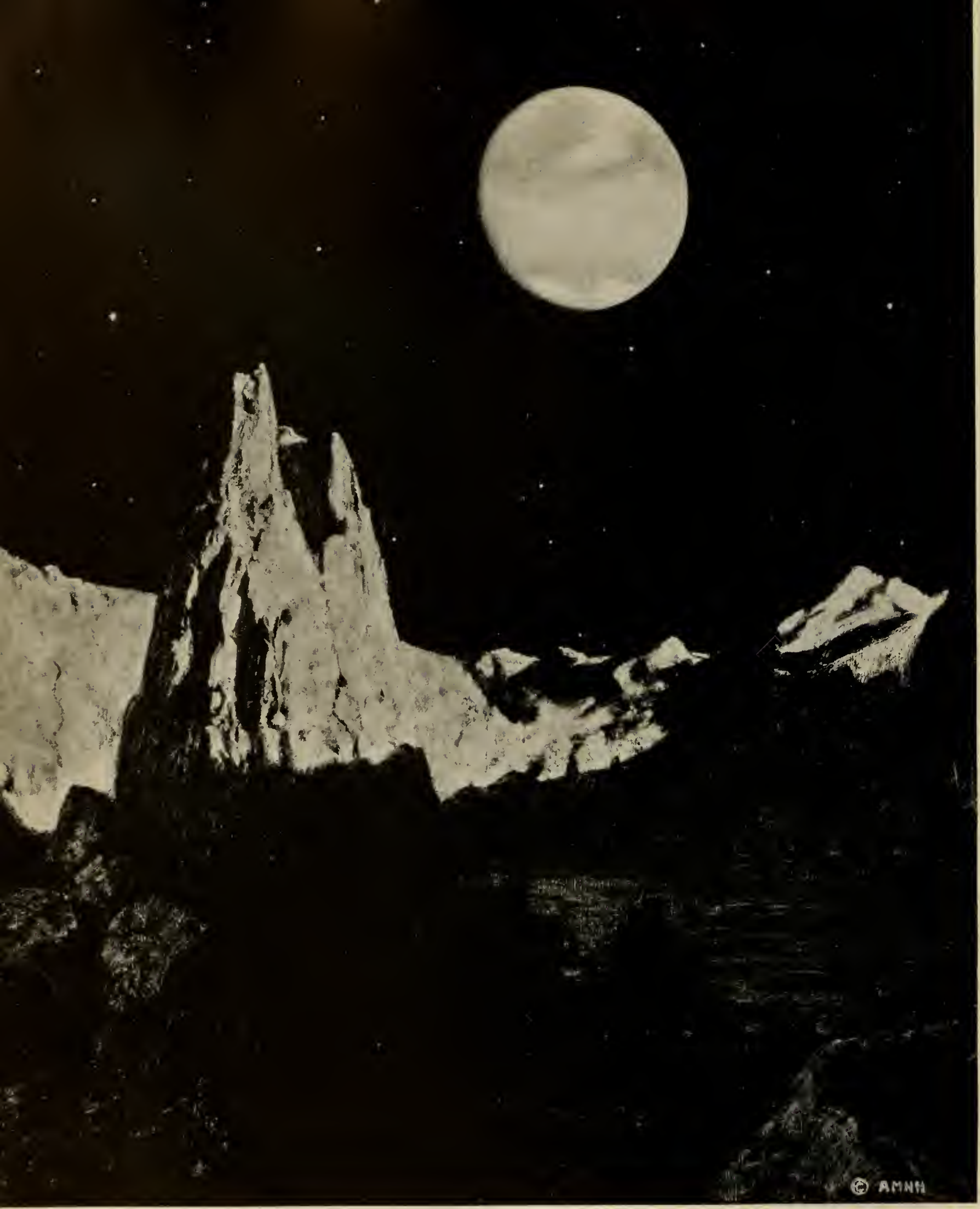
and

Moon

Yerkes Observatory



Full moon. Although only 1/400 as wide as the sun, the moon can cut it completely from earthly view because it is 400 times nearer. The spots on the moon's hard surface are great open plains, mountains, and craters—hot in sunlight, frigid in darkness

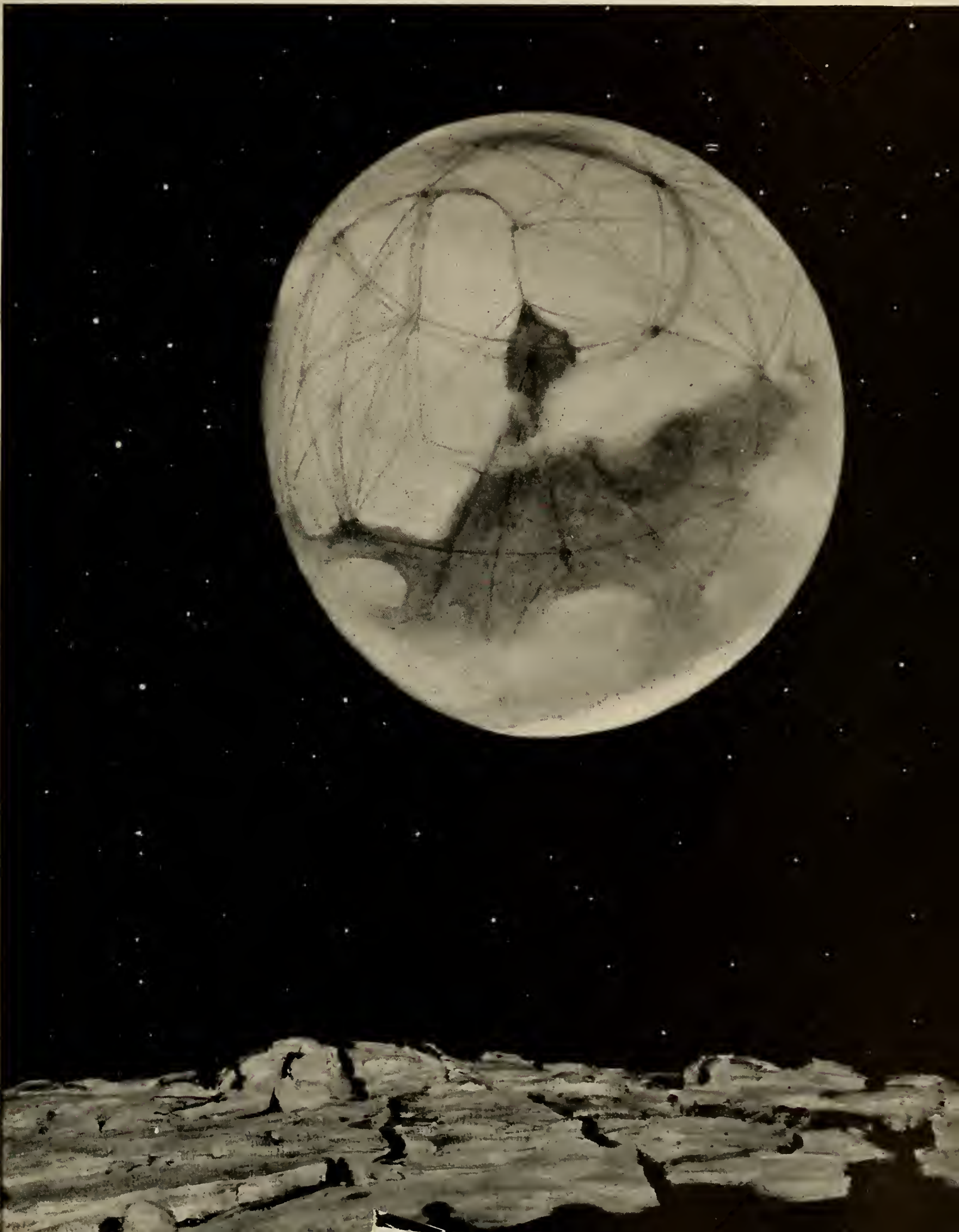


A Lunar Landscape

No atmosphere protects the moon's rugged surface, no twilight softens its shadows, no erosion rounds its jagged features, no life clothes its barren wastes. In the airless black sky, stars and planets are visible in the daytime. On the distant earth, which may be seen in the sky above, clouds and oceans proclaim it a more fortunate world. The Lunar Landscape, painted by Howard Russell Butler, is the joint conception of Mr. Butler and Dr. Henry Norris Russell

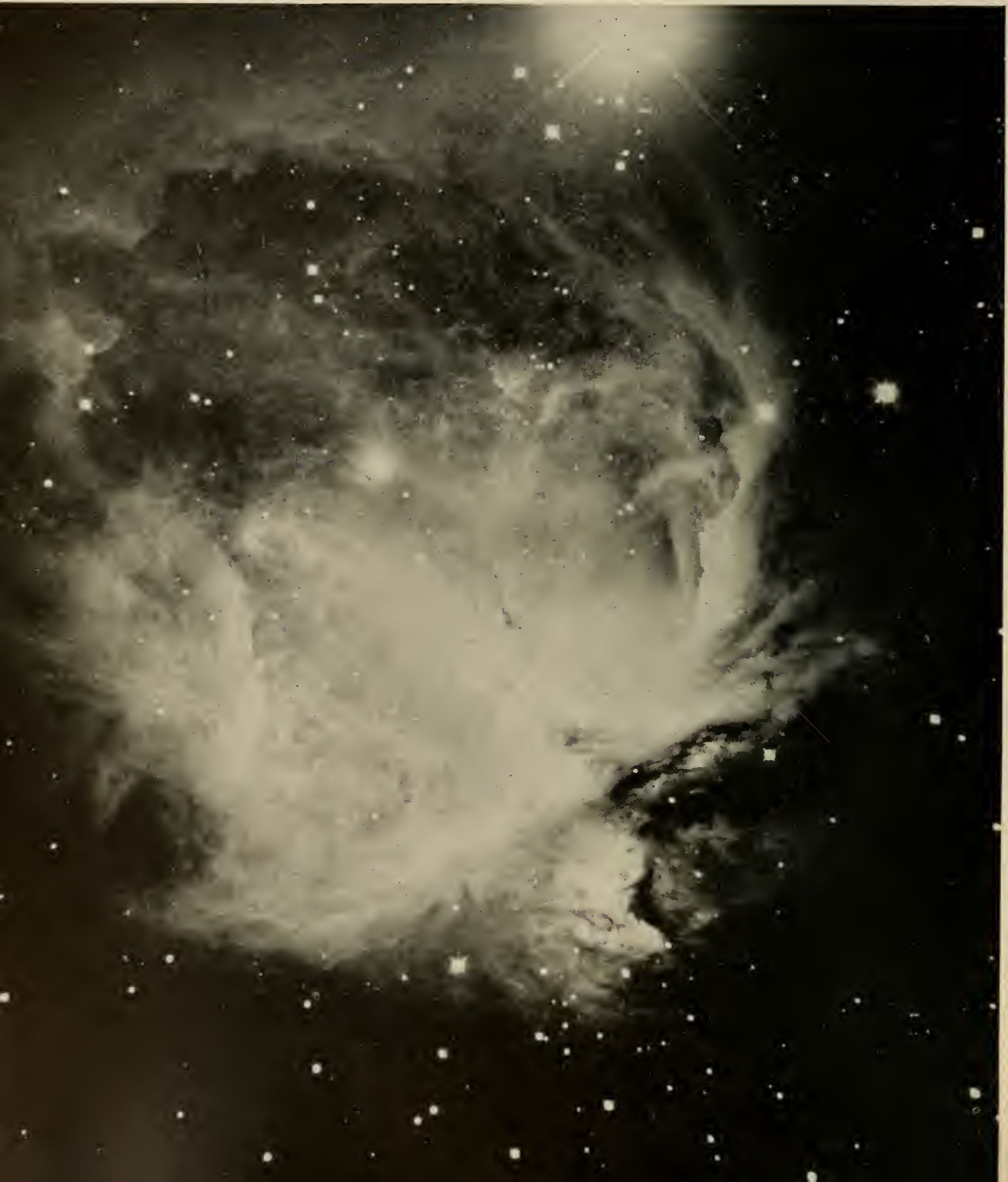
A planet like the earth, Mars is possessed of an atmosphere, a 24-hour day, seasons, and—perhaps some kind of life. The dark wedge of Syrtis Major, a polar cap, and drifting clouds are seen here as from one of the two tiny Martian moons

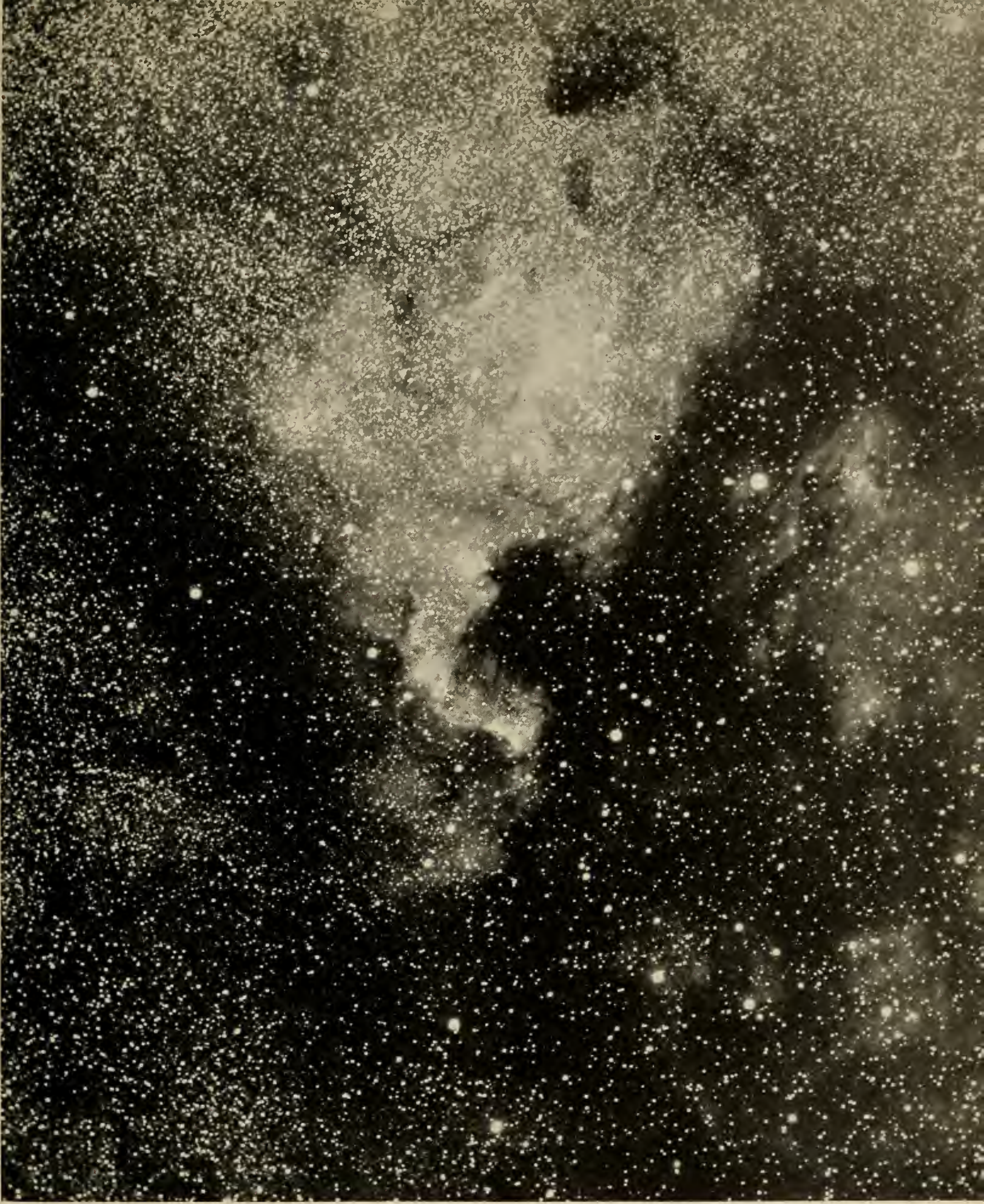
From a painting by Howard Russell Butler



Beyond the realm of the planets, the stars are scattered in space. Seen from the earth in groups, they form the star pictures or constellations. In one of these, Orion, the naked eye sees but a faint star in the sword where the camera records this immense gaseous cloud. Shining by its own light and by that of the four bright stars immersed in its center, it illuminates a vast sky area

Yerkes Observatory





Mt. Wilson Observatory

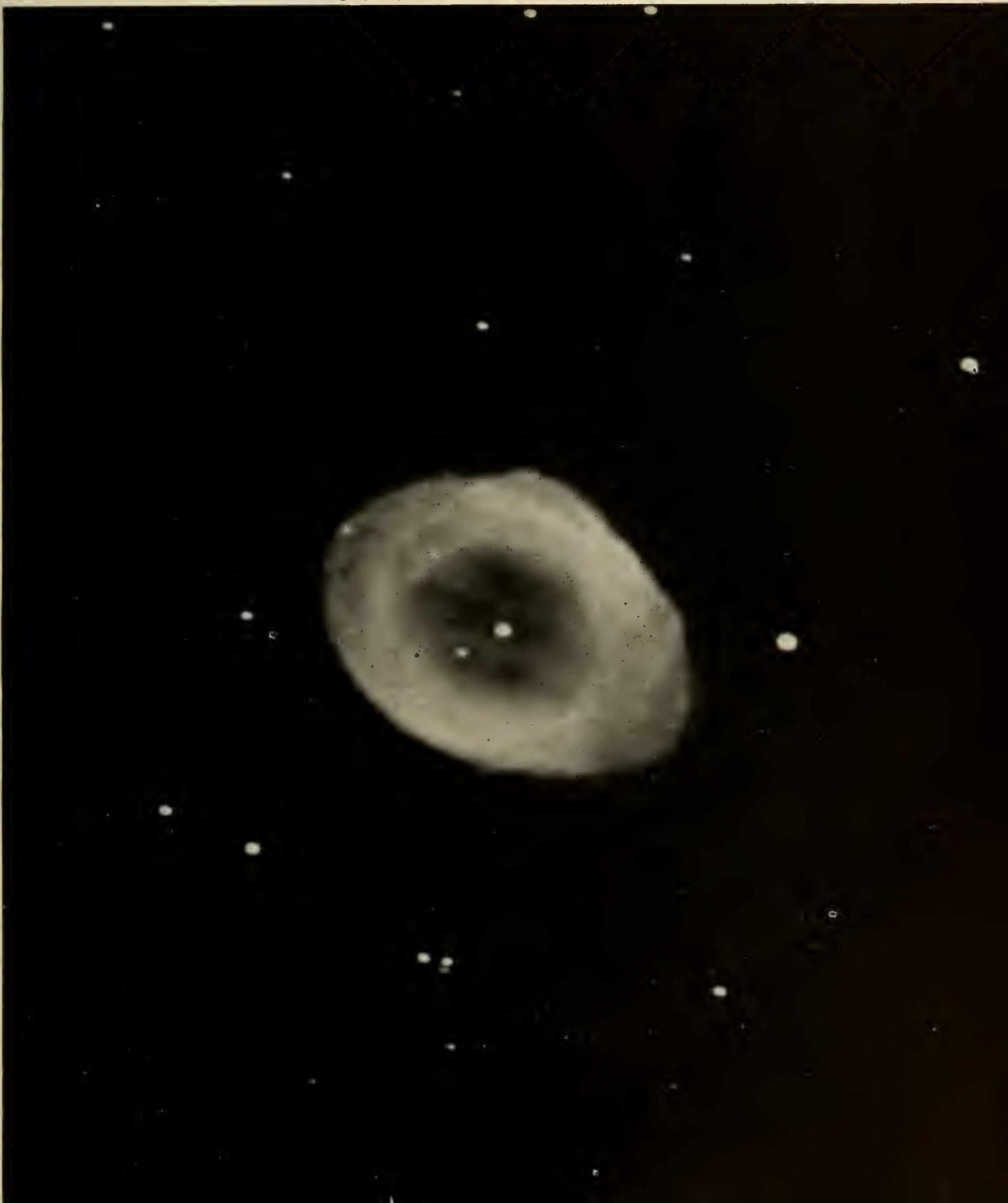
"North America" Nebula in Cygnus

Uncounted thousands of stars ceaselessly radiate light and heat to illuminate this vast gaseous continent in space, and yet it has never been seen by human eyes! Only the camera can see it, although it is millions of times larger than its counterpart upon the earth. In fact, if the whole of the known world were placed in its midst, the world would be but as a speck of dust upon a plain

(Left) Globular star cluster in Hercules. Light from the fifty thousand stars which make up this famous star cluster takes more than thirty-five thousand years for its trip to the earth. Strange that it should be but barely visible to the naked eye! Any one of these stars might be our own sun—possessed of light, heat, magnetic storms, prominences—and even a system of circling planets

(Below) Ring Nebula in Lyra. The ring nebulæ are of unusual beauty and of rare occurrence in the Milky Way galaxy. Their hollow spheres of gaseous material are lighted by the central stars which are among the bluest and hottest known. Distance removes them so far from view that the faintest stars visible to the naked eye are 9000 times brighter than these brilliant luminaries

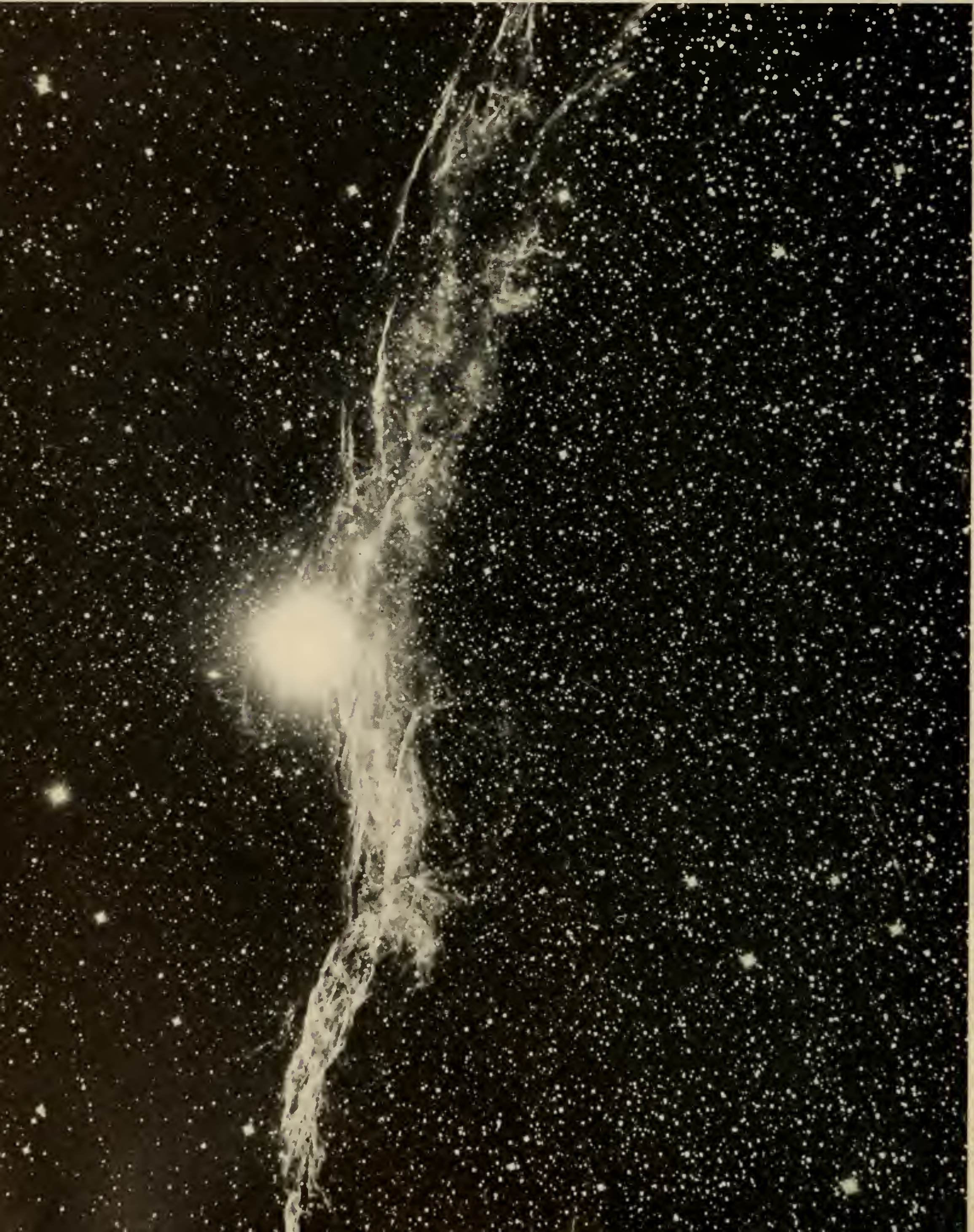
Photographs from Mt. Wilson Observatory

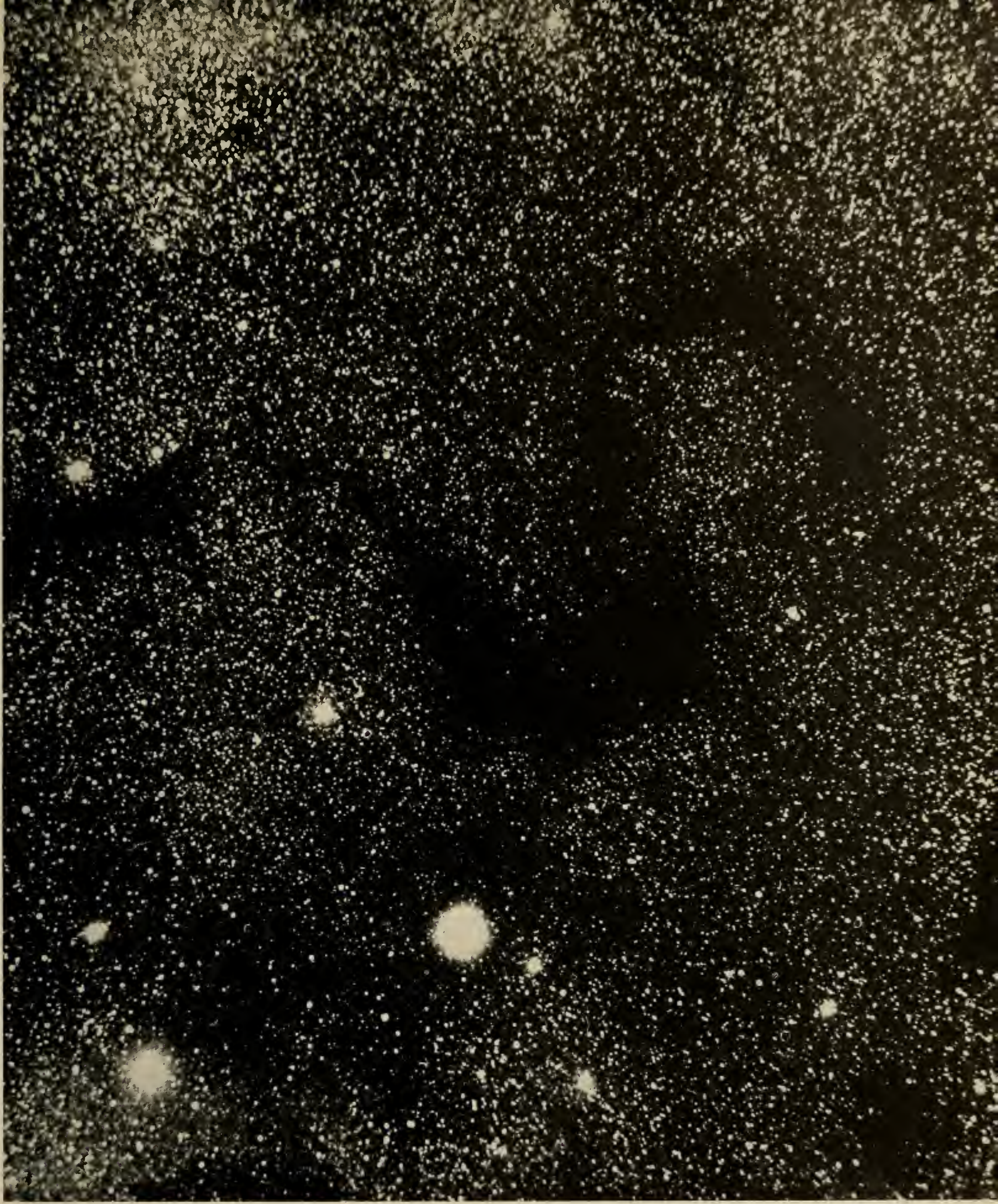


NETWORK NEBULA IN CYGNUS

This exquisite lacy film extends for millions of miles among the stars. As it moves slowly but steadily through space, its gauze-like wings hide myriad suns from view. It is invisible to the naked eye and a seventeen-hour exposure was necessary to catch its misty filaments upon the photographic plate

Mt. Wilson Observatory

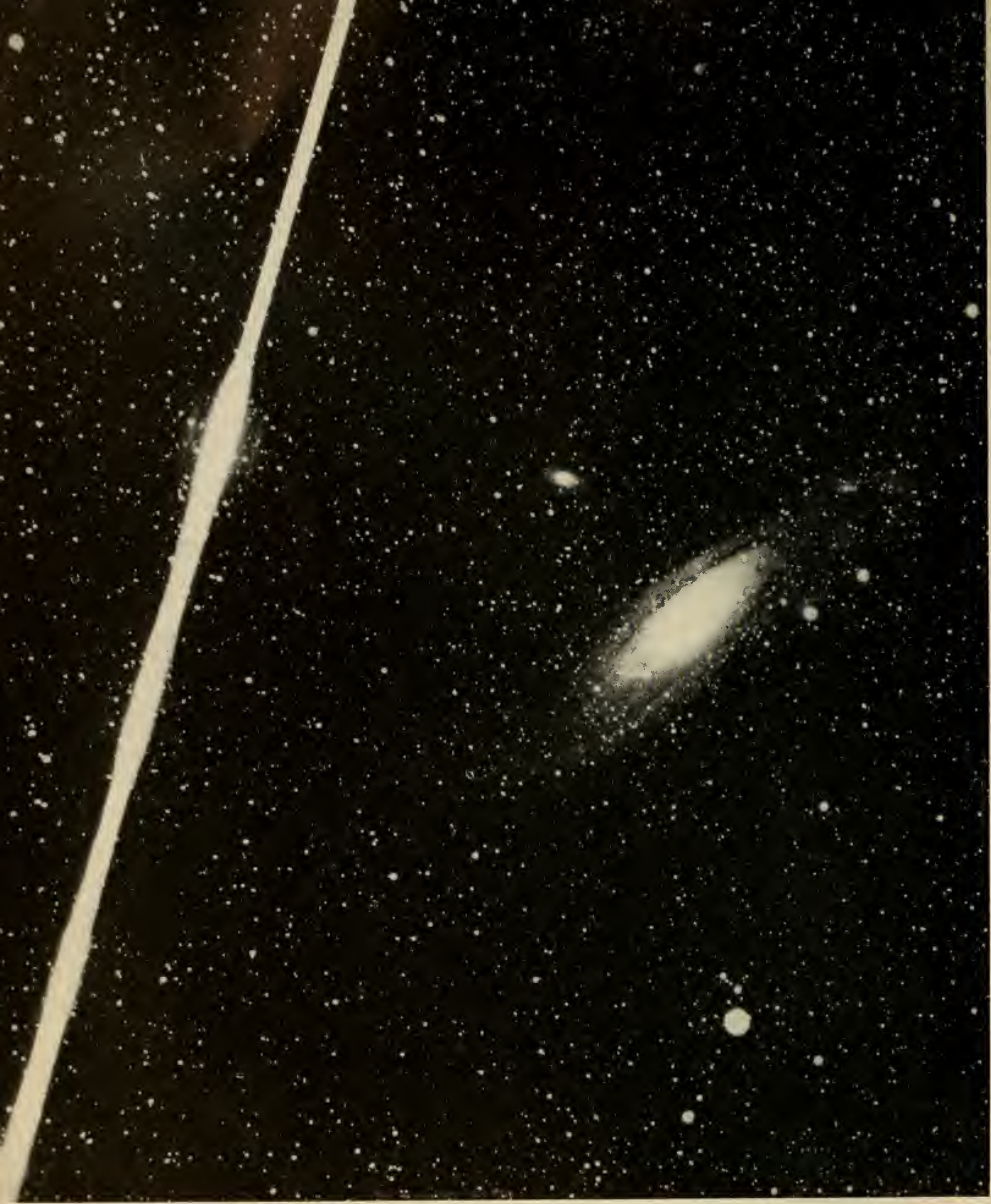




Mt. Wilson Observatory

DARK NEBULA IN OPHIUCHUS

Once thought to be holes in the sky giving view to empty space, the dark nebulæ are now known to be masses of opaque matter obscuring the light of the stars behind. The S-shaped obscuration winds in the midst of a star-studded region



Klepesta in Czechoslovakia

METEOR TRAIL

This photograph of the nearest of the remote island universes was almost complete when a near-by meteor flashed on to the plate, streaking across at the left. The pair are a paradox—the one, a giant star system far beyond our Milky Way galaxy; the other, a tiny bit of matter only a few miles from the earth's surface

Problems of Construction

Some of the interesting architectural and engineering difficulties which were overcome in building the Hayden Planetarium

By Wayne M. Faunce

Vice-Director and Executive Secretary, American Museum

The new Hayden Planetarium marks the culmination of ten years' effort to secure for the American Museum of Natural History in New York a Projection Planetarium—that marvelous piece of precision equipment for visual instruction and entertainment developed by the German firm of Carl Zeiss to demonstrate the fascinating drama of the night skies.

Plans for an astronomic section of the Museum were first developed in 1925 by the late Howard Russell Butler, in collaboration with the Museum staff and the architects, Trowbridge and Livingston. These early plans called for a five story building, to be erected on the site of the present Museum auditorium and to contain four large exhibition halls devoted to astronomical subjects. The uppermost hall was to be surmounted by a hemispherical dome, on the inner surface of which it was proposed to project images of the heavenly bodies. For this purpose, the Zeiss Projection Planetarium was considered, and Dr. Clyde Fisher, now curator of the Hayden Planetarium, went to Germany with the chief object of studying two installations which had then been made of this extraordinary instrument, the invention of Dr. W. Bauersfeld of the engineering staff of Carl Zeiss, Jena. Doctor Fisher returned with great enthusiasm for the possibilities of the Projection Planetarium and it became a definite feature of the plans for the Museum's proposed astronomical building. Not until 1933, however, were sufficient means found to finance such a project.

In the spring of 1933, the Trustees of the American Museum formed a separate corporation, known as The American Museum of Natural History Planetarium Authority, thereby becoming eligible to apply to the Reconstruction Finance Corporation for a loan on a self-liquidating basis to construct and equip a Planetarium. Mr. Charles Hayden of New York became interested in the project and made the generous, public-spirited offer to donate both the Zeiss Projection Planetarium instrument and a large Copernican Planetarium which was desired for installation on the first floor.

Breaking ground

Satisfied that the Museum's proposition was financially sound and that the anticipated revenue from admission fees would be sufficient to pay all operating expenses and amortize the investment in not more than twenty years, the Reconstruction Finance Corporation granted a loan of $650,000 to construct the Planetarium building. At the ground-breaking ceremony on May 28, 1934, Mr. Hayden turned the first shovelful of earth, and it was announced that, in appreciation of his magnificent gift of the two instruments, the building would be officially designated by the Trustees as The Hayden Planetarium.

In the preparation of the plans and specifications, the experience of existing planetariums in America and abroad was drawn on to the fullest extent. Dr. Philip Fox of the Adler Planetarium in Chicago, Mr. James Stokley of the Fels Planetarium in Philadelphia, with their respective staffs, and Mr. John C. Austin, architect of the Griffith Observatory and Planetarium in Los Angeles, coöperated in supplying general and technical information required to bring the plans as near to perfection as possible. Dr. K. A. Bauer, representing the firm of Carl Zeiss, Inc., and Mr. J. W. Fecker, the expert telescope builder of Pittsburgh, who designed and built the Copernican Planetarium, gave invaluable advice concerning the arrangement of the Planetarium instruments.

Working in close coöperation, the architects, Trowbridge and Livingston, the Museum's administrative and technical staff, and the Trustees' Advisory Committee, of which Mr. A. Cressy Morrison is chairman, developed the final plans for the two story and basement building, 146 feet long by 122 feet wide.

A dramatic effect

The great surmounting dome, with an outside diameter of eighty-one feet, is finished in copper, which has been given an effect of age by an artificial treatment rendering it a dark bronze in appearance. To enhance the attractiveness of the Planetarium at night, provision has been made for illuminating the dome and the front of the building by floodlights, concealed above the marquee and on near-by Museum buildings.

The Planetarium building as a whole has been built as a self-contained unit, although its operation will be an integral function of the American Museum. Every attention has been given to insure the comfort and enjoyment of visitors. Clean, conditioned air is provided throughout. During the warm months of the year, cooling equipment in the ventilating system will keep the temperature comfortably below that of the outside air, but not so low as to cause a disagreeable physiological reaction when one leaves the building.

Facilities for checking wraps are provided in the basement mezzanine, adjacent to the public lounge rooms. The broad stairways are provided with handrails down the center and along the side walls. For those whose strength might be overtaxed by the stairs, a small elevator is available. Ornamental settees have been distributed in the ambulatories at convenient points.

A brief discussion of some of the unusual problems encountered in the construction of the Planetarium building may be of interest.

Before excavation for the foundation was begun, it was known that the site of the Planetarium had once been a small pond, the remnant of a larger one which formerly extended from Eighty-first Street to Seventy-seventh Street. Long time residents in the neighborhood of the Museum distinctly recall this pond and according to their recollection it afforded fairly good cat-fishing in days before the growth of the Museum encroached on the area. This pond was probably fed by a small creek which until very recently was running underground in the Museum's square.

As the excavation for the foundations progressed, it became evident that the old fill had been dumped in rather carelessly, and more than forty years of settlement had not sufficiently consolidated the subsurface material to support the Planetarium building as originally planned, without extending the foundation down to bed-rock or to more substantial earth. In large areas, loose heaps of irregular bowlders from two to four feet thick, with sizable voids around them, were uncovered. At other points infirm material, such as ashes, was disclosed, and the shore line of the old lake was clearly discernible in places. To meet this adverse condition, the architects recommended that a system of foundation piles be adopted to provide proper foundation support.

A firm foundation

A combination of bearing piles and friction piles was driven. The bearing piles were forced down to solid rock and the friction piles were driven to such a depth that the resistance of the earth to further deformation, together with the friction on the sides of the piles, was sufficient to bear the required weight. A total of 326 piles was necessary. They were all of the concrete type. In placing them, a hollow, water-tight tapered steel shell was driven down by means of a 6,500-pound steam hammer, impinging on a steel core. At the proper depth, the core was removed and the shell filled with concrete.

The solution of the foundation problem was not quite so simple as the foregoing would indicate, because it was impossible to drive piles through the masses of loose rock. Consequently, forty-two pits for as many clusters of piles had to be laboriously excavated down to a level of ten feet below the basement so as to remove the loose rock, and conditions were such that it was necessary to do most of this excavating by hand. Then because it would have been unsafe to operate the fifteen-ton pile driver, towering sixty feet, on ground checkered with pit holes, extensive cradles and runways of twelve-inch by twelve-inch timbers supporting steel rails had to be erected over the pit holes to permit of moving the driver over the area of operations. Once it commenced, the pile driving was carried out with despatch, but not without considerable irritation to the nerves of residents in the neighboring apartment houses.

The Planetarium dome

In the design and erection of the Planetarium superstructure, there was no extraordinary departure from general building practice, except in connection with the dome. The pattern of the steel framework, as shown in the accompanying illustration, is perhaps unusual and certainly very interesting, but its design presented no unique problems. The structural dome, however, is quite different from those of other American planetariums. It is hemispherical in shape, eighty-one feet in external diameter, and its thickness is incredibly small, varying from three inches at the top to three and a half inches at the base or spring line, where it rests on a twelve-inch thick concrete ring bearing on the steel frame of the building proper. It is a shell type of structure entirely self-supporting, without the aid of trusses, hangers or other external features, and furthermore carries the weight of the inner or projection dome suspended from it and weighing approximately fifteen tons, including steel hangers. Of reinforced concrete, it derives its strength from its shape and the arrangement of one-quarter inch round iron rods, imbedded in the concrete. In Europe this method of constructing domed and arched surfaces has been used quite extensively but it is just beginning to be introduced in America.

The Hayden Planetarium dome was cast in place, but not by the usual method of pouring semi-liquid concrete into a form composed of two false-work surfaces, held apart a distance equal to the thickness of the finished concrete. A single faced wood form was employed, upon which was nailed a layer of "rock cork" one and one-half inches thick, which corresponded to the inside surface of the finished dome. Then the cement was blown into place by means of a cement gun. This remarkable device, known as the Akeley Cement Gun, was invented by the late Carl Akeley—that many-sided genius who was a member of the American Museum staff from 1909 until his death in 1926, and to whose memory the Trustees have dedicated the Akeley Memorial African Hall.

The inner dome, suspended from small T-shaped bar anchors imbedded in the reinforced concrete dome, is exactly seventy-five feet in diameter. It, too, is hemispherical and is carried down to an irregular horizontal line representing the sky line of New York City, nine feet from the floor of the Zeiss Planetarium chamber. Its main purpose is to serve as the projection screen of the Planetarium, but to achieve satisfactory acoustics, which means the prevention of disturbing echoes of the lecturer's voice and other undesirable reverberations, this inside dome has been made somewhat porous in character. This is so that sound will not be reflected from its surface to an excessive degree, but pass through and be absorbed by the rock cork lining of the structural dome.

The individual curved plates which make up the projection dome were lapped three-eighths of an inch and electrically "spot" welded along the laps at one inch intervals. One long edge of each plate is turned up at ninety degrees in a stiffening rib one inch wide, which also serves as a means of attaching the vertical hangers, on which the projection dome is suspended from the structural dome above.

A gigantic sieve

By a long series of experiments before the Fels Planetarium was built, it was found that a steel alloy of the stainless type lent itself best to the sort of fabrication called for in such a large spherical surface. Also, by conducting acoustical experiments with metal sheets of different thicknesses and different degrees of perforations, plates one-sixteenth of an inch thick, with a regular pattern of one-sixteenth-inch round holes, three-sixteenths of an inch apart, over the entire surface, proved to be best suited for the Planetarium purpose.

One might think that such a sieve would not provide a satisfactory projection screen, that as their images pass over the surface of the dome some of the small stars might disappear in the holes and that the dome would be too porous to represent the sky with any degree of realism. Fortunately, the smallest of the stars projected (none which can be seen by the unaided human eye are omitted) are larger than the holes, and under demonstration conditions there is no serious loss of light in this way. A final finish of flat white paint renders the dome an excellent reflecting surface without filling up the holes and during the dark demonstration periods or even when the room is moderately lighted to facilitate seating, there is very little visible evidence of the perforations. They do not detract in the slightest from the illusion of the night sky, and without such perforated treatment of the dome and the vertical circular side walls of the Planetarium chamber, as well, the room would be impossible acoustically. The echoes of the speaker's voice and the distortion of the incidental music would be intolerable.

Comfortable seating arrangements

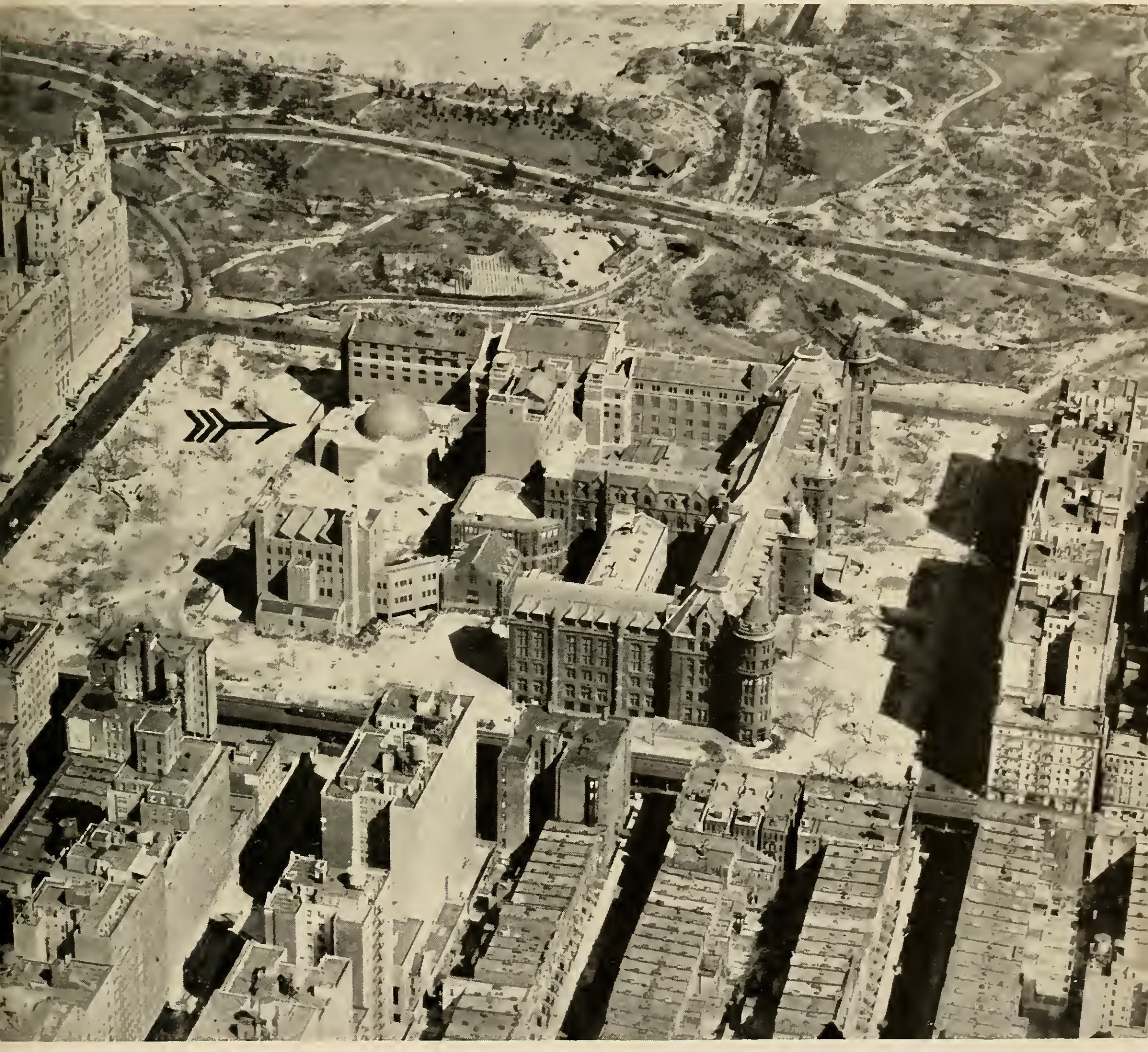
No other detail of the Planetarium equipment has been given as much thought and study as that devoted to the design of a special chair, of which there are 742 in the Projection Planetarium chamber. Several samples, embodying original ideas, were developed. These were experimented with, modified and, through the courtesy of the Franklin Institute, tested under actual demonstration conditions in the Fels Planetarium. All suggestions—and they ranged from the *chaise longue* through plain backless benches to hydraulically operated barber chairs, with head rests—were carefully considered. Apparently everybody who has attended a lecture in a planetarium has a different idea of the type of chair which should be used. In order to see all sections of the "sky," the observer must do a certain amount of craning and the Hayden Planetarium chair is designed to minimize strain on the neck and shoulder muscles. The back of the chair is shaped to allow free twisting of the shoulders and yet it supports the observer's back comfortably in a relaxed position. A ten degree tilt backward adds to the comfort and the brackets supporting the short curved arms are set back far enough to permit easy turning. The body of these chairs is wood, with a black finish. They are rigidly fixed in concentric circular rows on iron pedestals bolted to the floor.

In connection with the lighting (there are no windows in any of the exhibition or demonstration spaces), many unique problems had to be solved. The general overhead illumination in the exhibition corridors is quite subdued in order not to interfere with the transparencies; nevertheless, exhibits in the center of these passageways, such as the large meteorites on the first floor, have to be properly lighted. Inconspicuous ceiling fixtures, which direct the light downward through concentric circular vertical vanes, have been installed to control this illumination. They provide adequate lighting for the floor exhibits but restrict the distribution of light, so that very little from these sources diffuses to the side walls. The transparencies required special lighting and careful experiments were necessary to develop a diffusing arrangement which would flood them with a uniform light, sufficiently intense to bring out all the details of these spectacular photographs.

The fruit of experience

The Museum is confident that the Hayden Planetarium will reflect favorably the thorough planning of all parts of the building. It is the composite result of study and experiment by many technical experts and lay advisers, who deserve a large measure of credit for any success which may have been achieved. The experience of other planetariums has been the chief guide, and the staffs of these institutions have coöperated in every way in pointing out possible errors in design to be avoided. It is the belief of those who have been associated with the development of this project that in a happy combination it presents the advantages of both the Zeiss Projection Planetarium and the large Copernican Planetarium, brought together under one roof in a well-rounded educational plant. It is their firm conviction that it embraces the essential exhibits and demonstration equipment to instill in Museum visitors a deeper appreciation of the marvels of the universe and a clearer understanding of the many mysteries that we see in the heavens.

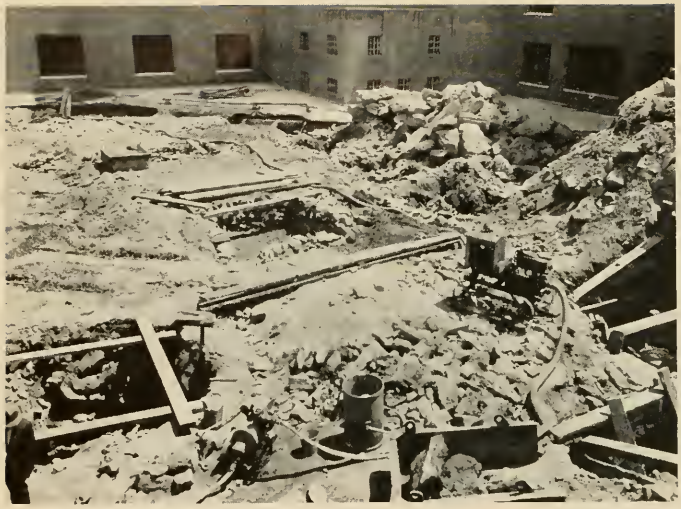
The Planetarium in the Making



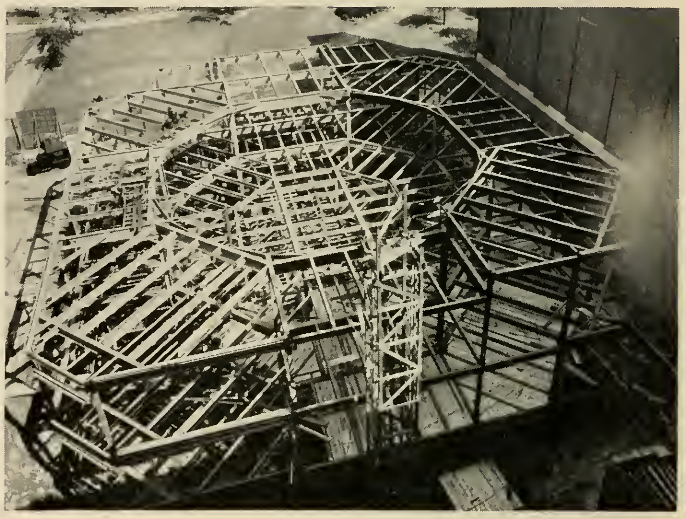
McLaughlin Aërial Survey

Aërial View of the Group of American Museum Buildings

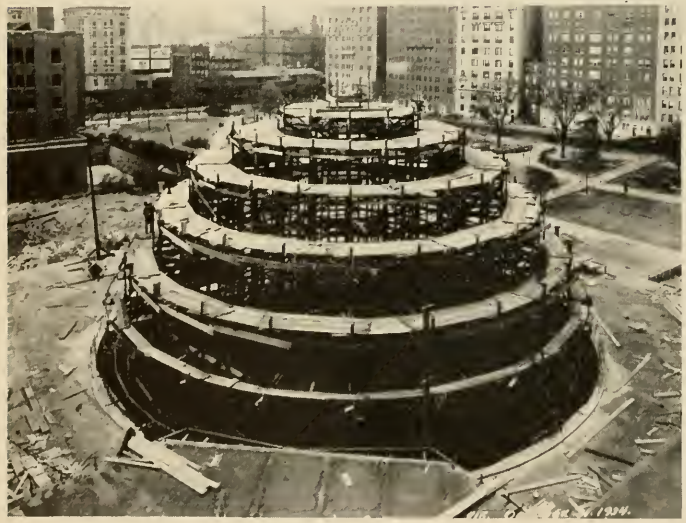
Taken from a southwesterly direction. The Hayden Planetarium, indicated by the black arrow, is located in the northeast court of the Museum's ultimate ground plan. Until the erection of future building sections planned for the north side and corresponding to the completed south façade, the Planetarium will be directly accessible from Eighty-first Street (to left of arrow) by an attractive approach landscaped by the Department of Parks of the city of New York. The hemispherical dome (appearing prominently in the picture) is a striking feature of the exterior. It, as well as the north façade of the building itself, can be illuminated by floodlights concealed above the marquee and on near-by buildings



(Left) The site of th Planetarium had evidentl been a dumping ground for loose rock excavated during the construction of earlier Museum buildings. Before the foundation piles could be driven, forty-two pits for as many pile clusters had to be laboriously excavated. Photographs on this page by R. L. Bertin, White Construction Company

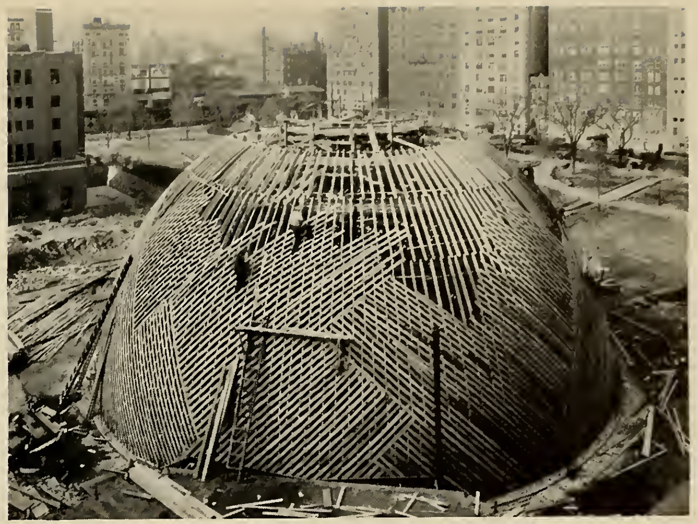


(Right) The steel framework for the Planetarium Building was of unusual design, providing for a two-story rectangular building with central circular rooms on both floors and for the support of a heavy concrete domed roof over the upper room



(Left) Circular platforms for the convenience of the mechanics who installed the horizontal pipe rings and the upright wooden ribs of the temporary form for casting the dome. This form was ultimately self-supporting, entirely free from the scaffolding seen in the picture

The temporary wooden form for the dome nearing completion. Near the top of the picture appears one of the horizontal pipe rings. Lower down, the upright ribs are in position between the rings, and on the lower part of the form, the diagonal bracing strips have been nailed on



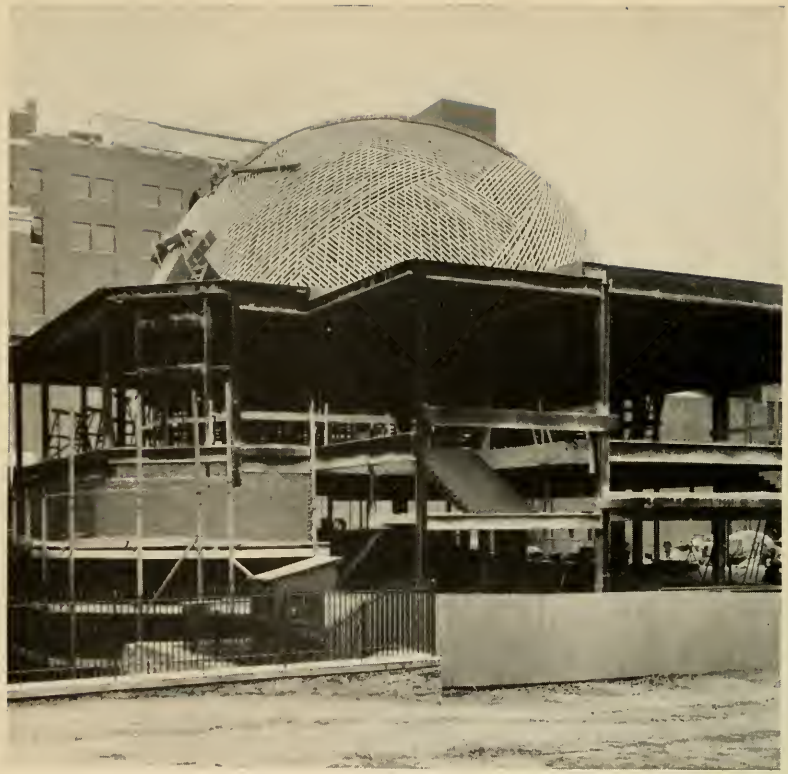
White Construction Company Photo

Eric J. Baker Photo

Not haphazard work, but carefully designed in advance of construction, so that the finished form did not vary from a true hemispherical surface more than a quarter of an inch at any point

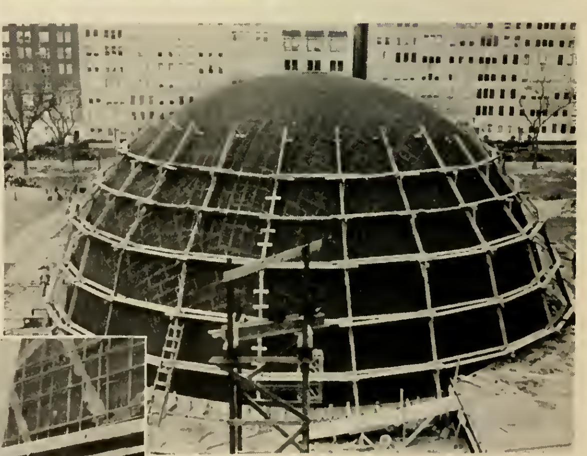
Workmen laying the slabs of insulation, the first permanent material of the dome, on the temporary form. Small-headed nails were used, so that they pulled through from the under side when the form was removed, without damaging the insulation

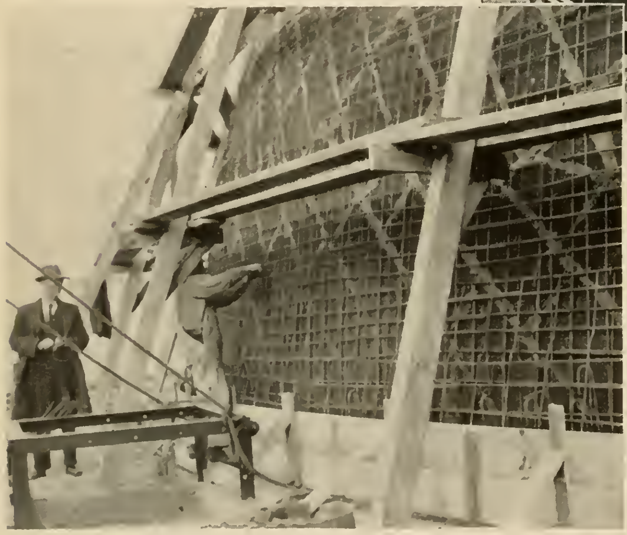
Eric J. Baker Photo



The concrete structural dome was cast over a falsework form unique in design. It constituted a self-supporting skeleton dome and was entirely removed after the concrete dome was finished. Photographs on this page by Eric J. Baker

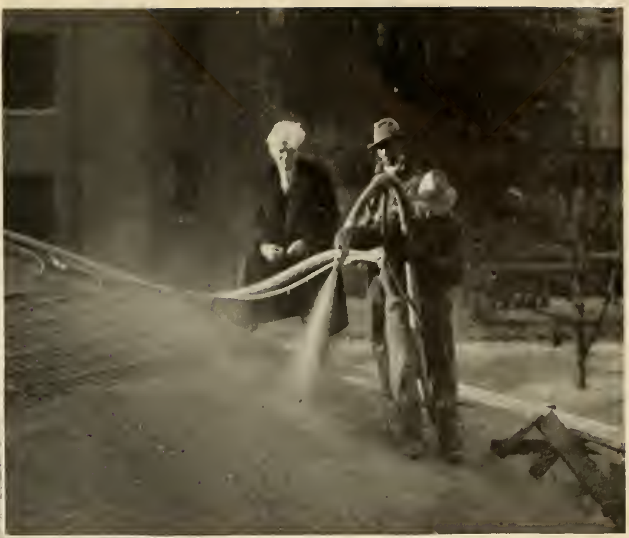
(Right) The completed 1½-inch layer of insulating material, known as "rock cork." This lining for the structural dome reduces the transfer of heat through the dome and also absorbs sound which passes through the perforations of the steel projection dome, thus preventing echoes of the lecturer's voice

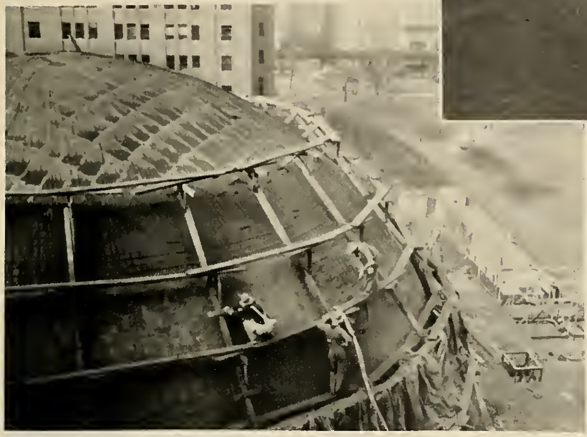




After the joints of the "rock cork" covering of the temporary form had been calked, a carefully designed pattern of iron reinforcing rods was woven over the entire surface of the dome preparatory to "shooting" on the concrete. The combination of steel rods, embedded in concrete, made a shell exceedingly strong for its thinness, which varied from 3½ to 3 inches

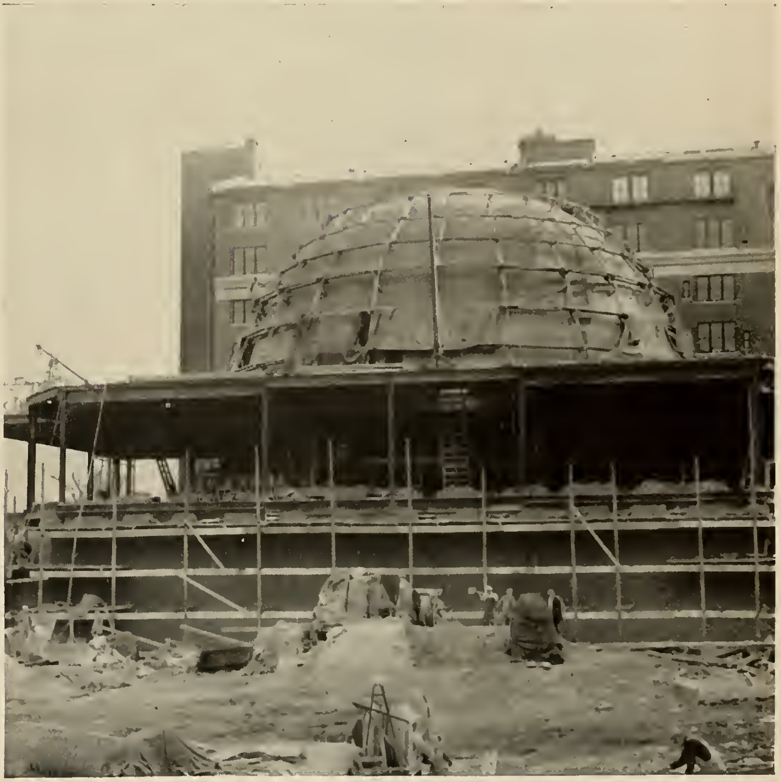
Dr. Clyde Fisher, curator of the Planetarium, watching the cement gun in operation during the casting of the concrete dome. This ingenious device was invented by the late Carl Akeley. Without the cement gun the concrete dome would have been impracticable to build, and other types of suitable domes would have been much more expensive





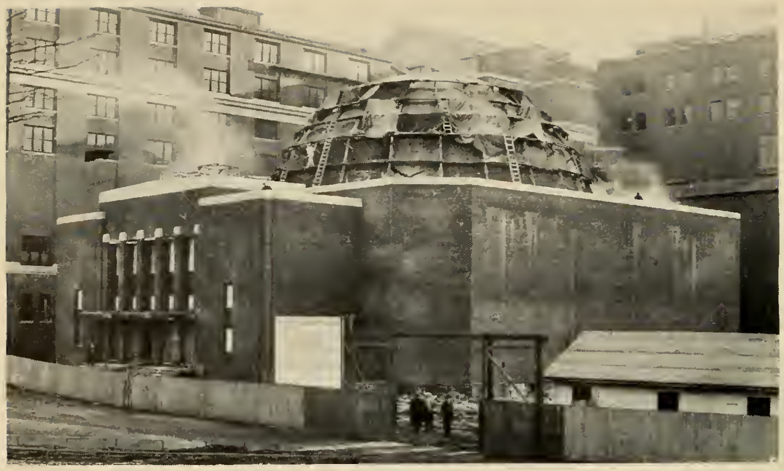
Eric J. Baker Photo

The cement gun was entirely satisfactory when "shooting" the steep slope of the dome, since the operator could control the consistency of the mixture by the water valve at the nozzle of the gun. Sand, gravel, and Portland cement were pumped dry through the larger hose to the nozzle by compressed air



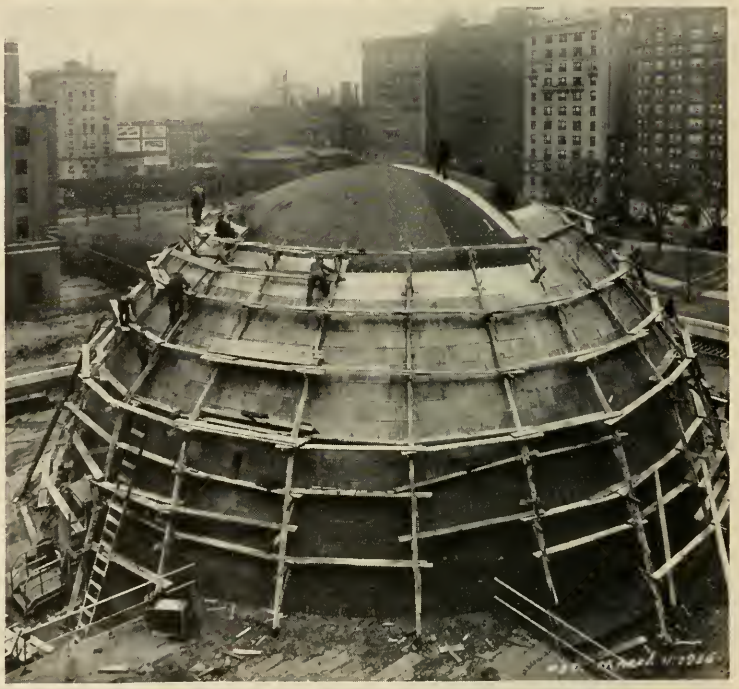
A view of the Planetarium during construction taken from the west, with the Whitney Wing of the Museum in the background. As the exterior brick walls were laid, work on the dome progressed steadily, and before severe cold weather set in, the building was fully enclosed

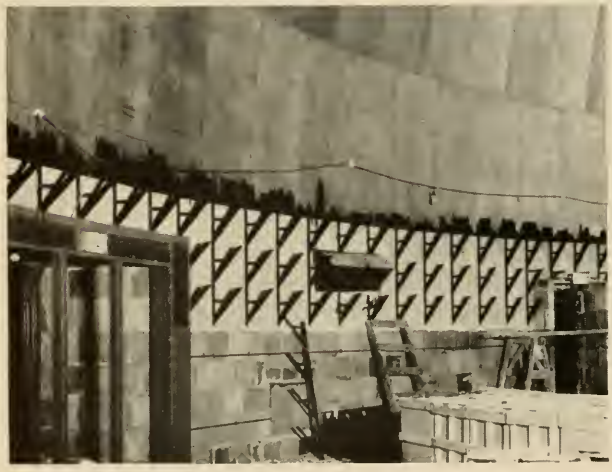
Eric J. Baker Photo



The Planetarium Building fully enclosed. While the concrete dome was being cast, midwinter conditions necessitated special protection against freezing temperature. Huge tarpaulins were employed to form a canopy over the fresh concrete. Photographs on this page by R. L. Bertin, White Construction Company

The dome, entirely weatherproof, with an outer finish of copper plates. This copper finish was finally washed with a solution of salt to age it artificially and render it a rich old bronze in tone





The assembly of the curved stainless steel plates of the inside hemispherical projection dome. The lower edge of the bottom row of plates at the level of the "horizon" of the artificial sky is cut out in a silhouette representing the skyline of New York City. The three rows of brackets appearing below were installed for the purpose of carrying overlapping metal plates set at an angle of 45 degrees to the vertical side wall. These plates are finished with a glossy, black surface so that any light hitting the side walls below the horizon is reflected to the floor and not seen by the audience

Astronomical Fiction

Amusing errors in astronomy to be found in literature, both ancient and modern

By FRANK C. JORDAN
Director of the Alleghany Observatory, Pittsburgh, Pennsylvania

MORE than fifty years ago, the Astronomer Royal of England, Sir George Airy, made the statement that not one person in five thousand knows that the stars rise and set. I have repeated this statement before groups of intelligent persons and found, to be sure, a deplorable ignorance on the subject.

Persons living in a city, surrounded by its lights, do not perceive the heavens. They know that the sun makes its apparent daily journey across the sky, but their knowledge of the moon, its motion and phases, is decidedly hazy. It is only when they get out into the country, away from lights, that they get a clear conception of the starry heavens, the grouping of stars, their motion across the sky, and their difference in color and brightness.

This lack of knowledge of the heavenly bodies and their motions has led to many amusing mistakes in literature, both ancient and modern. The classical example is found in Coleridge's "Rime of the Ancient Mariner":

> Till clomb above the eastern bar
> The hornèd moon, with one bright star
> Within its nether tip.

It is of course impossible for a star ever to appear within the crescent of the moon, for the stars are all far more distant than the moon and consequently never pass in front of its darkened face.

Dr. Clyde Fisher has called my attention to practically this same error in a modern book, *The Bridal Wreath,* where the sentence appears: "At the end of the street in the blue-green sky rode the new moon's sickle, with a bright star within its horn." The author possibly was influenced by Coleridge without recognizing the error.

There are two more possible errors in the passage from Coleridge. Though the context is not quite clear, it appears that the first half of the night is indicated, at which time the "horned moon" could not be rising in the east. However, it may have been the waning moon rising before the dawn. Be this as it may, other circumstances referred to in the poem, especially the very short twilight, imply that the ship was sailing in the tropics. The crescent moon then would be lying flat on its back, and there could be no "nether tip." A line through the tips would be parallel to the horizon.

Strange ways of the moon

Edgar Allan Poe, in *The Descent into the Maelstrom,* commits a very glaring error. A ship whirling about in the funnel of the Maelstrom (an error also, for the Maelstrom forms no funnel) is lighted by the full moon, which shines directly overhead. This happens on the first of July when the full moon is far south of the equator and would barely rise above the southern horizon for an observer in Norway. To add to the error, the moon six hours later is setting in the west, whereas in reality a celestial object in the zenith in Norway would not set at all, but would be in the circle of perpetual apparition. Furthermore, on July 1 Norway would not have any night, and moonlight would be superfluous.

H. Rider Haggard, in *King Solomon's*

Mines has a party of whites about to be overtaken and slain by a band of savages. They providentially escape because of the occurrence of a total eclipse of the sun during which they stumble along in total darkness for more than an hour. This is truly a remarkable eclipse, for the longest that can possibly happen is a little more than seven minutes, and even then it is not very dark. The evening of the same day they were helped along by the light of the full moon. This of itself is a startling occurrence, for a solar eclipse happens only at new moon, and full moon occurs only after a lapse of two weeks. But in fiction anything may happen. Astronomers so took Haggard to task, however, that this was changed in later editions.

A young and sentimental writer started a story in this way: "It was midnight, and the new moon was just rising in the east." This moon must have got its trolley off the wire, for in the experience of most of us the new moon is always setting in the west, and does not remain visible until midnight.

Mrs. Gene Stratton Porter in her very delightful nature novels plays fast and loose with the moon. She can have it shining whenever and wherever she pleases, and it can do strange things. At one place in *The Harvester*, the half moon is just at the tree tops on the western horizon, which is quite proper. But later in the night it has risen clear of the trees and is flooding the country with light. This is of course impossible, for the moon never rises in the west. In another place it is stated that the moon every night made a bridge of light across a small lake. This could happen for a few nights, but not indefinitely.

Planting "in the moon"

Many gardeners and farmers plant things "in the moon," root crops in the dark, aërial crops in the light of the moon—or perhaps just the reverse. This belief that the moon exerts a strong influence upon vegetation seems to rest partly on the argument that if the moon produces the tides, it should likewise have some effect on the water in the soil. No account is taken of the fact that the moon has the same effect on the tides whether it is in the dark or the light phase. Tides, morever, are purely a physical phenomenon, while plant growth depends upon chemical reactions. If one argues that moonlight favors plant growth in a manner similar to sunlight, the reasoning is likewise slipshod. We sometimes hear it said at the time of full moon that it is as light as day. Actually the light of the full moon is visually only about one six-hundred-thousandth as strong as full sunlight. A simple photographic experiment demonstrates this difference. Whereas in full sunlight an exposure of one hundredth of a second will produce a strong negative, in moonlight an exposure of two hours, or 720,000 times as long, will be necessary. So it is an exaggeration to claim that moonlight can exert any appreciable photosynthetic effect on vegetation.

• *The moon and the weather*

I once knew a man who always planted his potatoes "in the moon." One year when the moon was right other conditions were all wrong. To wait another month for the moon would be too late, so in desperation he planted in the wrong time of the moon. His crop that year was the best he ever had. That converted him. Just a little reasoning or experimentation would cure many people of queer ideas.

It always worries an astronomer to see a painting in which the horns of the moon are directed toward the horizon, yet this is a common error. Actually they should point away from the horizon, because they always point away from the sun, which is below the horizon at night. Artists may see more in a scene than the average person, but they do not always see the heavens correctly.

Some persons profess to be able to predict a dry or wet month from the orientation of the crescent moon, depending upon whether it lies on its back or is at a considerable angle with the horizon. These positions have nothing whatever to do with mundane affairs, but are the result of the relative positions of the sun, moon and earth, which can be predicted years in advance. In latitude of the northern United States the crescent in the winter is on its back, while in summer it is more nearly vertical. The weather, on the other hand, is decidedly capricious. Many persons swear by the prediction in patent medicine almanacs, not realizing that these predictions may have been made by the office boy, or some one equally ignorant of the weather. They are necessarily sometimes correct, but one correct prediction near at hand hides several false ones farther away. The experts of the weather bureau seldom venture to predict farther than a week in advance, and even then are extremely tentative in their statements.

Dr. E. E. Barnard, the famous astronomer, did not like the book *Ben Hur,* because Sheik Ilderim's racing horses were named after stars which have Arabic names given them about 1000 A. D., while the events of the book took place at the beginning of the Christian Era. Such anachronisms are rather common in literature as well as in art. It is like putting a spyglass in the hands of Columbus, or placing an American flag at the head of Braddock's army. General Lew Wallace also made another error in the *Prince of India.* An astrologer was on the house-top at midnight viewing the planets, among them Venus. Now a terrestrial Venus may keep late hours, but in India the celestial Venus is always tucked away below the western horizon before midnight, and does not appear above the eastern horizon till near the morning dawn.

Multitudes believe implicitly in the pseudoscience, astrology. That the stars and planets can have any influence whatever on the lives of human beings is utterly indefensible. Astrology has served only one fortunate purpose, namely in early years when the study of it led to the real science of astronomy.

Seeing stars by daylight

There is a pleasant fiction that from the bottom of a deep well or a lofty chimney in the daytime a bit of dark sky may be seen, spangled with stars. A very bright star might be seen, but certainly no others. The writer of a story had the hero fall into a deep pit, apparently without any serious injury to life or limb, but he remained there through the light hours of the day without rescue. His one ray of hope was one bright star which remained directly overhead all day. A very accommodating star. The writer was one of the 4999 out of every 5000 persons who do not know that the stars move across the sky.

A certain hazy condition of the sky makes it act like a mirror. In Pittsburgh we have often seen what the Alleghany Observatory staff calls "furnace comets." They are faint yellowish vertical beams of light about 5° or 6° in length, which are the reflection of the flame of a Bessemer steel converter, and do look like comets. Most of the people of the city have never seen one, but when a person is so fortunate as to see one, he calls up the Observatory to find out about his discovery. During the apparition of Halley's Comet in 1910 there were one or two nights in which several of these were visible at once. Then the Observatory telephone was kept busy. One message came:

"I see three comets; which is Halley's?"

One evening a woman called and asked "Am I looking at Halley's comet?"

She was answered "Yes."

"Oh, thank you," was her reply.

Of course we did not know where she was looking, but if she saw a comet, it was certainly Halley's, for no furnace comets were visible at the time.

Persons call and tell of some strange light in the sky, and ask for an explanation. When they are asked where it appeared, the answer is likely to be: "Just over the top of a certain hill, or above such-and-such large building." This of course conveys no information, and when asked the direction in which it appeared, the replies are apt to be very hazy as to the points of the compass.

About two years ago, when Venus was so bright in the northwest sky, the impression got abroad in Pittsburgh that it was a beacon light sent up by balloon from Akron airport. We finally exploded that idea by the argument that, since Akron is 100 miles from Pittsburgh, and Venus appeared at least 30° above the horizon, that light would have to be 50 miles above the earth's surface. This is a good example of how little thinking is done by the average person when some startling idea is advanced.

Read any work of fiction or poetry, and there is a chance of finding astronomical errors. Not in all, however. One striking exception is that of Lord Tennyson, who, it is said, never made such a mistake. The secret is, that before writing any astronomical statement, he always consulted the Astronomer Royal. I would commend such a course to any writer not up on his astronomy.

"Read a little astronomy once a month or oftener, and see your astronomer at least twice a year."

The Birth of the Solar System

Facts, theories, and hypotheses that explain, or attempt to explain how the earth and other astronomical bodies were formed

By Clyde Fisher
Curator of Astronomy, American Museum

Our earth has not always been as it is now. It is difficult to understand how the early natural philosophers, though doubtless influenced by religious teachings of the day, could have believed that things were created essentially as they are—the beds of coal, ranging in series from the peat bog, through brown coal, bituminous, anthracite, to graphite; the deposits of limestone and its metamorphic marble; even the fossils in the rocks.

But those days are past. We now realize that there is "nothing unchangeable except eternal changeableness."

One can observe profound changes taking place in the short space of a human lifetime. And if we read the record in the rocks, we see evidence of far greater changes which took place before man came upon the scene, even before the beginning of either plant or animal life on our planet. Further, if we turn a telescope on Mars and use with it the spectroscope and the photographic plate, we note evidence suggesting that similar changes may have taken place on that planet.

Naturally we have come to wonder about the origin of the earth and its companion planets, and of the sun around which these bodies move.

The age of our solar system—that is, the time that has passed since the great catastrophe which started its development—is estimated to be from two to ten billions of years.

One's earliest astronomical observation is probably that the sun rises in the east, passes across the sky, and sets in the west. Our forebears of not many centuries ago supposed from similar observations of the moon and the stars, as well as of the sun, that the earth was the center of the universe. Although in everyday life this explanation seems adequate for all practical purposes, we now know that it is incorrect.

It was not until the astronomers had made the important distinction between real and apparent motions, not until they understood that the sun was the center of our solar system, that any intelligent theory for the origin of these bodies could be framed.

The nebular hypothesis

The first scientific theory of the origin of our solar system (and it was a magnificent conception) goes back to the philosophers Kant and Swedenborg. Since it was developed and put into scientific form by La Place, it has been known as La Place's Nebular Hypothesis or Theory, depending upon the credence given. (A hypothesis is more than a guess. It must have some evidence in its favor, and must not be contrary to proven facts. A theory must have more evidence in its favor; while a law is a theory proven beyond doubt. So, hypothesis, theory, and law are relative terms, there being few hard and fast lines in nature.)

According to this Nebular Theory, the sun and all of the planets and their satellites and the asteroids were once a huge, rotating, gaseous nebula, which extended out beyond the present orbit of Neptune. As this nebulous mass cooled it contracted and, since we recognize no resisting medium in space, the speed of rotation increased. As the whole mass contracted, the circumference grew correspondingly smaller, so that the part at the surface went round more times in a given period. This increase in the speed of rotation was accompanied by increase in centrifugal force, or the force by which a revolving body tends to fly *from* the center.

So it was with the mass of the outer part of our theoretical nebula. And when this force had increased until it balanced the pull *toward* the center (centripetal force or gravity), the inner part of the great nebulous mass contracted away from the outer rim or shell of the nebula. It was not conceived that this rim or outer shell was thrown off like drops of water from a grindstone or mud from a carriage wheel, but that it was left balanced between centrifugal force and gravity, and still rotating. This rim or shell, which may not have been complete, or even uniform in thickness, was supposed then to have drawn together into a more or less globular mass, under the influence of gravitation, by which every particle of matter attracts every other particle.

Thus the outermost planet and the rest of them in succession were supposed to have been formed, the one nearest to the sun being produced last of all. In the case of the asteroids, or tiny planets which occur between the orbits of Jupiter and Mars, it is supposed that this shell, instead of forming a single mass, took shape in more than a thousand small masses.

The moons or satellites of the planets were supposed to have been formed in the same way, after each individual planet-mass had been left balanced between gravity and centrifugal force, still revolving around the central portion of the original nebulous mass.

As the nebulous matter condensed and cooled, it changed from gaseous to liquid form and then to solid in the case of the four terrestrial planets, as Humboldt called the four inner ones, Mercury, Venus, Earth and Mars. The four outer or major planets, Jupiter, Saturn, Uranus, and Neptune, although they present only an outer surface of cloud, may be solid underneath the cloud. Very little is yet known about Pluto.

Two kinds of evidence

When the nebular theory was first conceived, it was thought that there were two kinds of evidence in its favor: First, there were certain features in our solar system whose existence the theory would account for; and second, there were systems outside our own in phases suggesting the early phases of our own system.

Evidence of the first kind was most impressive, for it was thought the theory would explain the following conditions:

(1) The orbits of all the planets and nearly all of the asteroids are practically in the same plane, which determines that these bodies occupy a narrow belt in the heavens only a few degrees wide. No planet is ever found near the North Star or even near the Big Dipper, and none is ever found near the Southern Cross, but all are always found in the narrow belt called the Zodiac.

(2) The orbits of all the planets and almost all of the asteroids are nearly circular.

(3) All of the planets and asteroids revolve around the sun in the same direction.

(4) The sun rotates on its axis in the direction in which the planets revolve, and its equator is but little inclined to their orbits.

(5) The planets of greater density are nearer the sun.

(6) The moons or satellites revolve about the planets in the direction in which the planets themselves rotate (except the eighth and ninth satellites of Jupiter and the ninth satellite of Saturn).

(7) The orbits of the satellites are nearly circular and nearly in the plane of the planet's equator (except for the eighth and ninth satellites of Jupiter and the outermost satellite of Saturn).

It is not reasonable to suppose that such conditions as these are due to chance and therefore insignificant. If the situation were the result of chance, we would expect to find the planets and asteroids scattered over the sky and revolving around the sun or around each other in many and diverse ways. As it is, the conditions point to a common origin and to an orderly development.[1]

The second kind of evidence—namely, phases in systems outside of our solar system which suggest stages in the development of our own—consisted chiefly in nebulæ.

The first nebulæ to be discovered, the Great Nebula in Andromeda and the nebula in the sword of Orion, can be seen with the naked eye, and many more have been discovered with the telescope. Sir William Herschel observed faint diffused nebulæ, others in which a nucleus can just be discerned, and others in which the nucleus is a brilliant starlike point. No telescope has been made that is powerful enough to reveal planetary systems around any of the stars other than our sun, if they exist. But the spiral nebulæ certainly do appear to be solar systems in the process of development. A striking example is the well-known Whirlpool Nebula in the constellation The Hunting Dogs.

---

[1] A generation ago Simon Newcomb and other leading astronomers believed that the nebular theory was "almost a necessary consequence of the only theory by which we can account for the origin and conservation of the sun's heat." The British astronomer, Sir Robert S. Ball, explained this phenomenon thus: "As the sun loses heat, it contracts, and every pair of particles in the sun are nearer to each other after the contraction than they were before. The energy due to their separation is thus less in the contracted state than in the original state, and as that energy cannot be lost it must reappear in heat. . . In this way we can reconcile the fact that the sun is certainly losing heat with the fact that the change in temperature has not been large enough to be perceived within historic times."

Larger telescopes to be sure, resolved some of the so-called nebulæ into stars. At first this was thought to be fatal to the nebular theory, because of the natural conclusion that still larger telescopes might resolve the rest of the nebulæ into stars. But the invention of the spectroscope proved that some nebulæ were irresolvable. Thus spectrum analysis reëstablished the nebular theory on a firmer basis than ever.

Downfall of the nebular theory

As investigation has gone forward in recent years, however, the nebular theory has lost the weight of the evidence thought to be furnished by the spiral nebulæ, for these are now believed to be immense island-universes or galaxies—great assemblages of stars—far outside of our own galactic system known as the Milky Way Galaxy.

The abandonment by present-day astronomers of this splendid speculation, the nebular theory, seems to be due to two objections.

First, it is now believed by many astronomers that an extended tenuous ring or shell would not condense into a single body, but into many bodies, like the asteroids or the rings of Saturn.

The second objection centers in the distribution of angular momentum in the solar system. The angular momentum of a planet is computed from its mass and the angular distance it traverses in a given time. Almost all the angular momentum of the bodies comprising the solar system—98 per cent of the total—is at present associated with the major planets (Jupiter, Saturn, Uranus, and Neptune), which embrace only 1/700 of the total mass. The sun's rotation provides almost all of the remaining 2 per cent, so that the four terrestrial planets (Mercury, Venus, Earth, and Mars) contribute less than one-tenth of 1 per cent of the whole. No acceptable theory has yet been advanced to explain through forces entirely within the solar system, how 98 per cent of the angular momentum could have been segregated in less than 1/700 of the total mass.

The nebular theory attempted to explain the origin of the solar system under the action of forces entirely within the system, but this is now believed by many astronomers to be impossible. The present distribution of angular momentum is believed to be due to forces from outside of the system.

The planetesimal theory

About twenty years ago Chamberlin and Moulton of the University of Chicago proposed an alternative theory, which would not be subject to the difficulties mentioned above. At first their theory was usually referred to as the planetesimal *hypothesis*, but now it certainly should be dignified by the term "theory."

According to this conception, our sun in the remote past was a star without planets, and another sun or star (for all stars are suns, and our sun is a star) in its journeying through space came so close to our sun that it caused a tremendous disturbance, pulling out great masses of the sun and starting them on their revolution around the sun. By a kind of explosion, due to the disturbance of gravity, myriads of these masses were projected into space, probably varying greatly in size, and these were the so-called planetesimals.

Not only was this new theory free from the fatal difficulties of the nebular theory, but it was found to explain the many features of the solar system pointing to a common origin by an orderly process—to explain them indeed in some cases better than the older theory.

The myriads of planetesimals which were left revolving around the sun, were slowly gathered together by the action of gravity into the planets, asteroids, and satellites. Perhaps the meteors are stray planetesimals, and perhaps the comets, which in some cases seem to be related to meteors, may also be accounted for by this theory. However, the comets have never been very definitely included in either the nebular theory or the planetesimal theory.

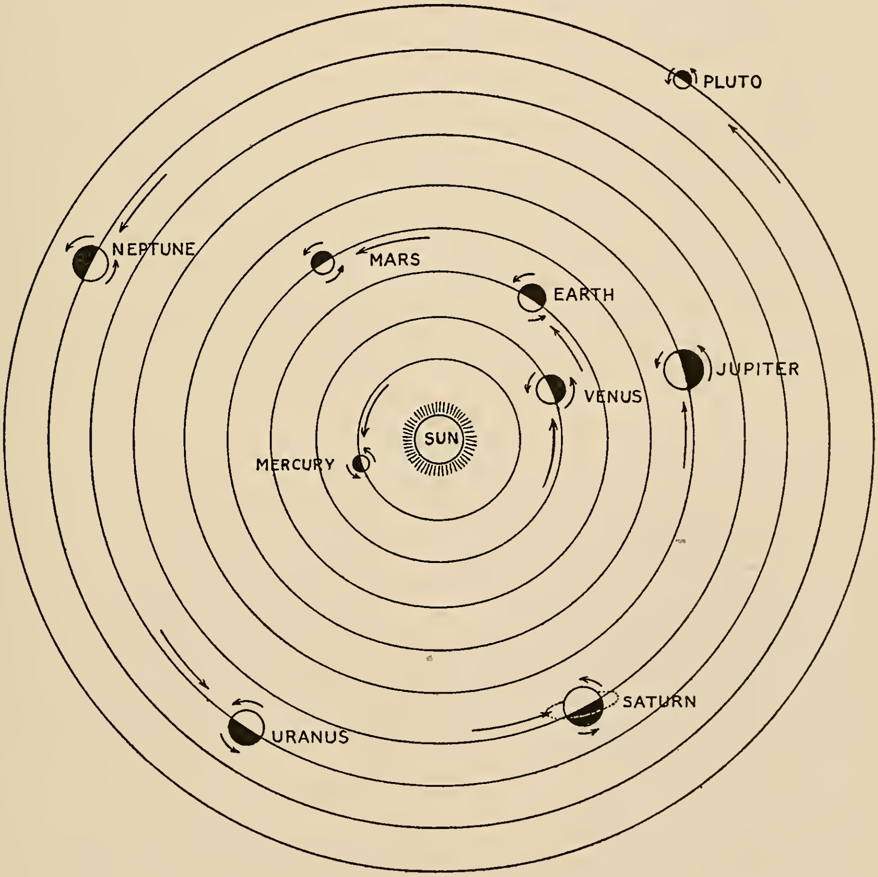
In his *The Two Solar Families* Professor Chamberlin considers the comets and the meteors to be children of the sun, yet "not a brood—in the full sense that this is true of the planetary family—but an unrelated succession of independent births."

The craters on the moon were formerly believed (and still are by many astronomers) to be of volcanic origin. But there is much in favor of the theory that they were caused by the impact of planetesimals or meteorites.

The tidal theory

There have been modifications of the nebular theory, and there have been modifications or substitutions suggested for the planetesimal theory. Among the latter should be mentioned the tidal theory of Jeans and Jeffreys. These men agreed with Chamberlin and Moulton in the occurrence of a near-encounter between our sun and some other star and in most of the essential results of that event.

According to the tidal theory, however, Jeans conceives that instead of myriads of masses (planetesimals) having been pulled out of the sun, all of the planets, asteroids, and other bodies were pulled out in one tremendous cigar-shaped mass of gas, which later broke up into these bodies. The largest planets, Jupiter and Saturn, according to this theory came from the middle of this huge, spindle-shaped cigar, while the terrestrial planets came from one tapering end and the outer smaller planets



THE SOLAR SYSTEM

Diagrammatic drawing of the solar system showing that all the planets revolve around the sun in the same direction, and rotate in the same direction that they revolve from the other end. In accordance with this view, the planets must have possessed nearly their present masses from the time of the "dynamic encounter."

Since the tidal theory, or the tidal form of the dynamic encounter theory was advanced, Jeffreys has come to the conclusion that there was a *real* collision, although a grazing collision, between our sun and this other star, instead of a near-collision.

From the standpoint of probability a real collision is many, many times less likely to occur than a near-collision. This is evident when one thinks how much less probable it is that another star should actually strike our sun, than that it should pass within say one hundred million miles of it, which in the present sense might be called a near-collision.

The principle of Roche's Limit

Then there is another difficulty with the theory of real collision, and that is the principle of Roche's Limit, as pointed out by Professor Chamberlin. In the establishment of this principle it was calculated that a satellite could not approach its primary closer than 2.44 times the radius of the primary without being pulled apart into small fragments by the strong differential attractions of the two bodies. The planets, to be sure, are believed to have come from the sun, but any theory of their origin which depends upon the annihilation of the sun is obviously impossible. The sun was gaseous and already predisposed to eruption, and if a larger star were to pass it at less than the Roche limit of the star, the sun would be dispersed and the star would be likely to carry off most of the wreckage. Thus it seems impossible that there could have been a real collision between the sun and a star of a larger size.

The star which caused the disturbance resulting in the birth of the planets, whether larger or smaller than the sun, must have passed close enough to the sun to pull out one seven-hundredth of its mass, for that is the total mass of all the planets in comparison with the mass of the sun.

There seems to be no doubt that at the present time the prevailing theory for the origin of the solar system is the dynamic encounter theory, that is, the planetesimal hypothesis of Chamberlin and Moulton, or some modification of it such as the tidal theory of Jeans.

It is only fair to say, however, that to the minds of many astronomers this explanation is doubtful. Whether it will be supplanted by some such theory as that presented by Professor Dinsmore Alter, in which he calls for no outside forces, remains to be seen.

According to Professor Alter's theory the planetesimals were formed from the solar atmosphere without the necessity of an encounter with another star. He suggests that the increase of angular momentum necessary to cause the planets to separate from the sun might have been secured through *radiation pressure.*

An example of *radiation pressure,* readily observable, is seen in a comet with a tail. While the comet approaches the sun, its tail is behind it; when it swings around the sun at its closest distance from the sun (perihelion), its tail is at right angles to the path; and while the comet is moving away from the sun, its tail is ahead of it. In other words, the tail of a comet always points away from the sun—and this is due to the radiation pressure of the sun.

After the planetesimals were formed, the evolution of the planets according to Professor Alter's theory proceeds in exactly the same manner as that outlined by Chamberlin and Moulton in the Planetesimal Hypothesis.

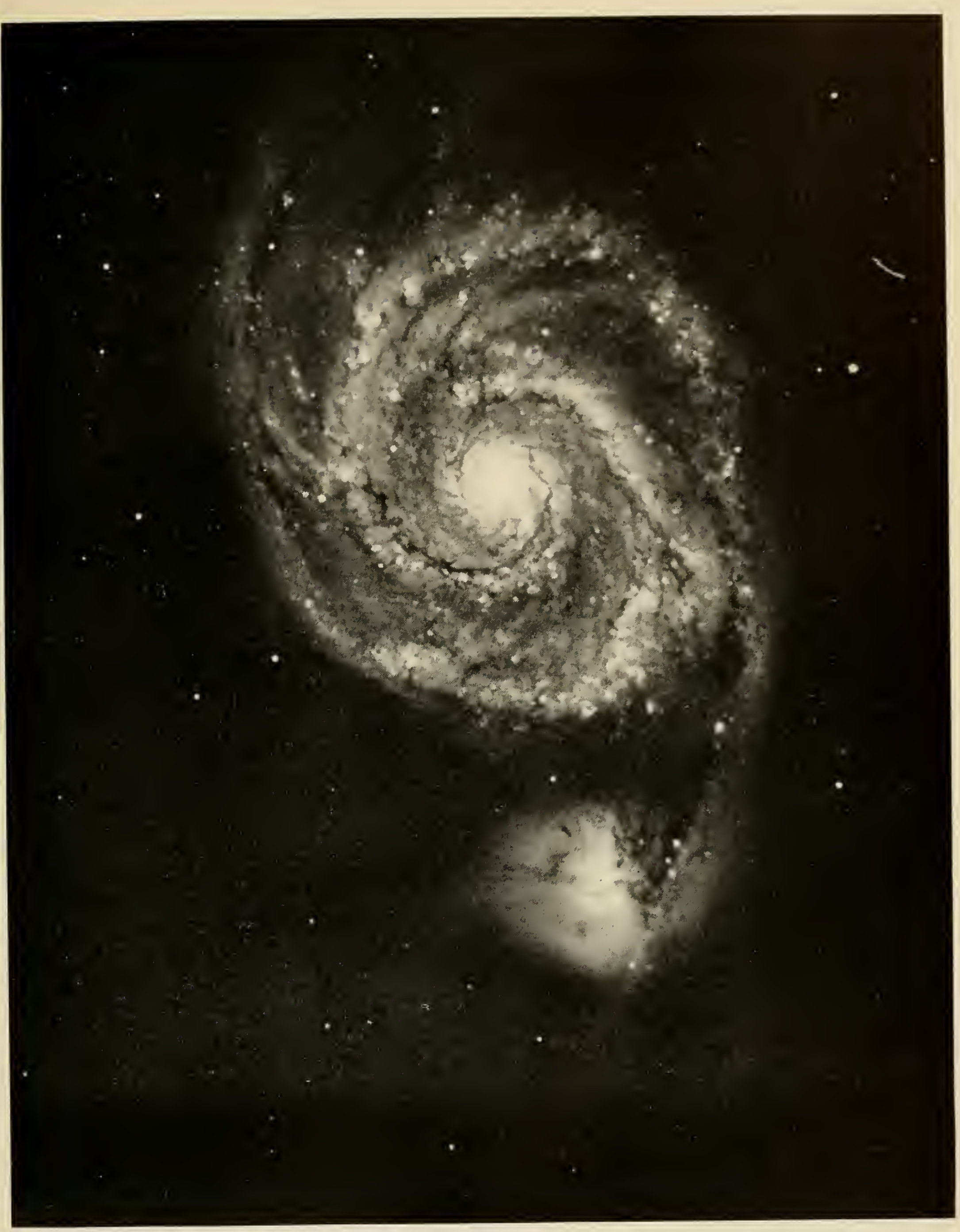
The recent behavior of Nova Herculis in increasing and decreasing and increasing again in magnitude evidently does not lend itself to dynamic encounter explanation.[1] Perhaps here is a hint that our solar system was not formed by a dynamic encounter at all.

When we comprehend the relation of the earth to the solar system, and wonder about its origin, and when we get a glimpse of the relation of the sun to our galactic universe, the Milky Way system, and realize that there are millions of galaxies far beyond the limits of ours, we naturally wonder whether they are in any way related to one another. The natural tendency of all knowledge to "unity and simplicity" makes us feel that they are.

> That very law which moulds a tear,
> And bids it trickle from its source,
> That law preserves the earth a sphere,
> And guides the planets in their course.
>
> —Samuel Rogers

---

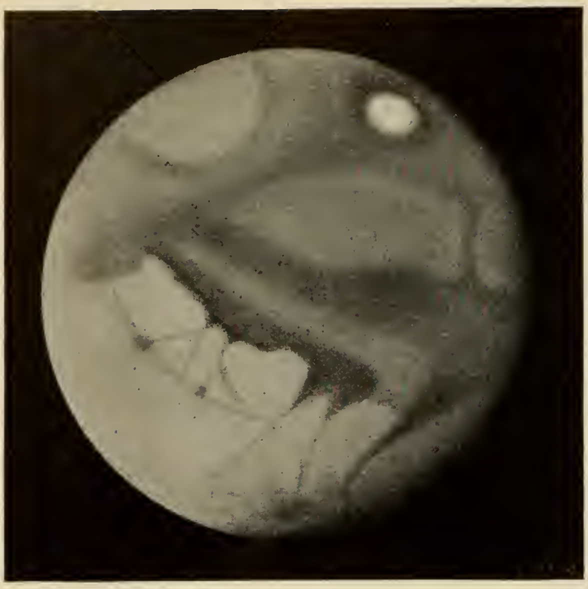
[1] This phenomenon has been noted in the following issues of Natural History Magazine: February, 1935, page 170; April, 1935, page 353; and May, 1935, page 440.



Courtesy of Mt. Wilson Observatory

THE WHIRLPOOL NEBULA

This great spiral nebula in The Hunting Dogs (Canes Venatici) *was photographed on May 15, 1926, by an exposure of three hours with the world's largest telescope, the 100-inch Hooker reflector. Originally it was thought to be a solar system in the process of formation, according to the Nebular Theory. Now it is known to be a great assemblage of stars, an island-universe, similar to our Milky Way Galaxy*

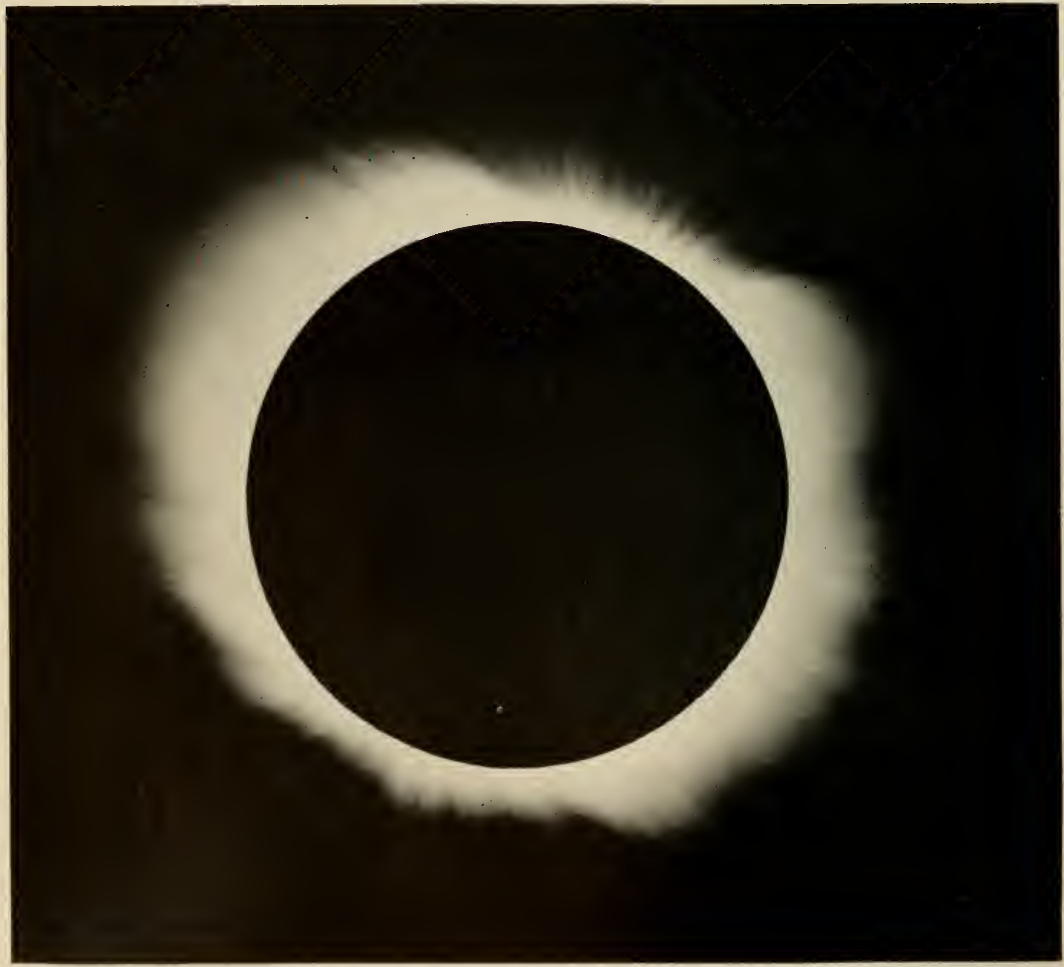


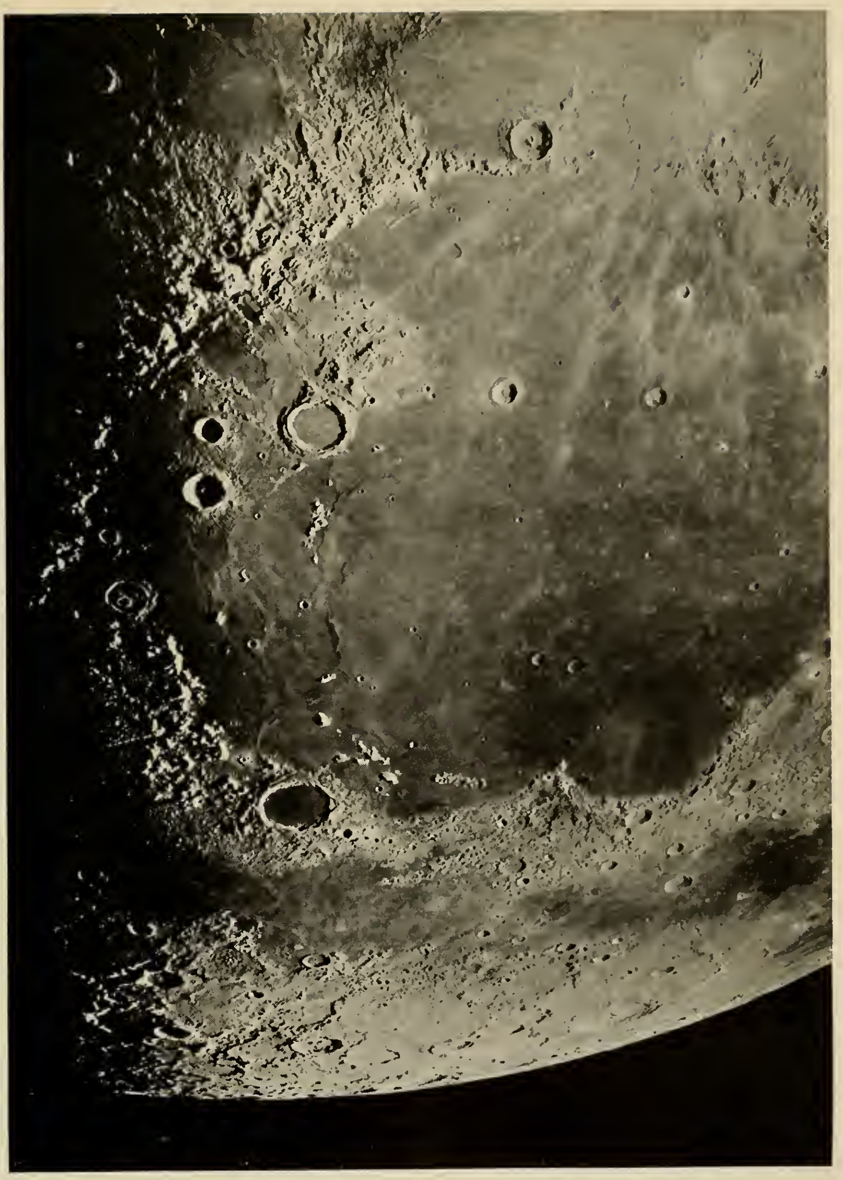
Courtesy of Observatory at Paris-Meudon

(Left) Mars, the ruddy wanderer of the sky. This drawing of Mars by Prof. E. M. Antoniadi is based upon studies made through the 33-inch telescope at Meudon, the largest refractor in use in Europe. The increase and decrease in size of the polar caps (the south polar cap being shown) are evidence that Mars has seasons similar to those on the earth

(Below) This photograph of the total eclipse of the sun, of May 28, 1900, shows the corona—both the polar and lateral streamers—in fine detail. The shape of the corona is correlated with the periodicity of sunspots

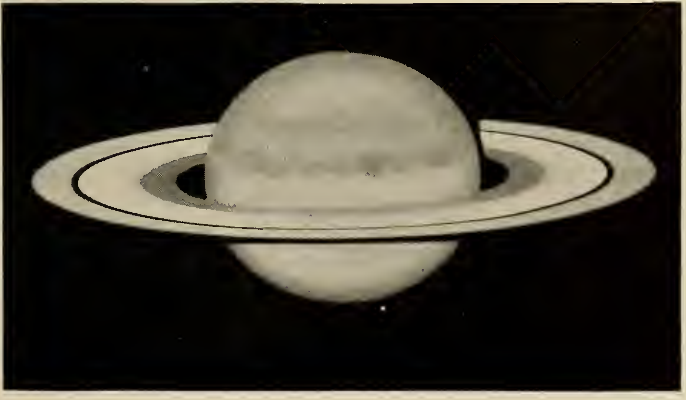
Courtesy of the Yerkes Observatory





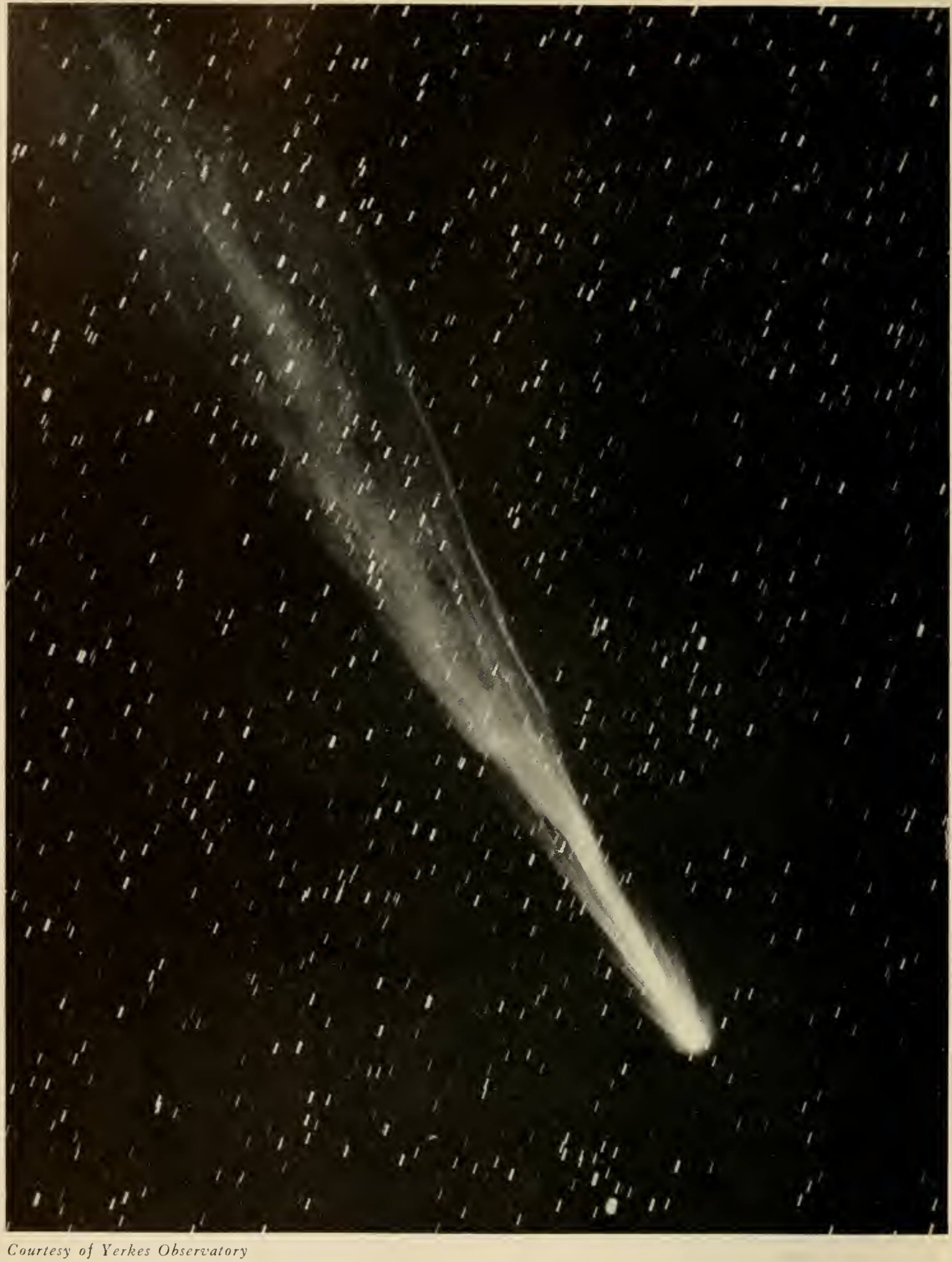
Courtesy of Mt. Wilson Observatory

Courtesy of Observatory at Paris-Meudon



(Above) The northern portion of the moon showing Crater Copernicus in the upper right-hand corner; the lunar Apennines in upper left with Crater Eratosthenes at the right tip of the range; and other features

(Left) Saturn and his "fiery" rings, now known to be cold and composed of millions of small solid bodies or "moonlets." From a drawing by E. M. Antoniadi



Courtesy of Yerkes Observatory

Moorehouse's Comet

The above picture shows one of the most beautiful comets of the present century, as photographed November 16, 1908. The stars have made short streaks on the plate, because the telescope was made to follow the comet during the long time exposure. The exquisite tail was so tenuous, as the tails of comets always are, that one could see the stars through it almost as distinctly as in other parts of the sky

Ancient Man and His Universe

Interesting and ingenious conceptions held by many ancient peoples concerning the universe and the part their own earth played in the scheme of things

By MARIAN LOCKWOOD

Assistant Curator of Astronomy and the Hayden Planetarium, American Museum

ASTRONOMY, or the study of the heavenly bodies, is undoubtedly one of the most ancient of the sciences.

When the first man stood on his first hilltop, and looked out across wide stretches of primeval country, watching the beautiful colors of the sunrise as the light of day came out of the east—at that moment man became a lover of the skies, and astronomy as a science was coming to birth. As he rose night after night from his bed of leaves or skins, he watched the heavens for the first sign of day, confident that the dawn would bring to him again the mysterious warmth and light of the great round disk which passed so slowly and majestically over his sky day after day.

As time went on, he began to wonder where the sun came from and where it went when it sank so quickly into the west. At night, as he watched the stars appear one by one, he wondered about those lights that shone so brightly in the sky. And the moon—where did it come from—was it the other side of the sun's face?

In time he even questioned the part that he himself and his familiar world had to play in this great parade of sun and moon and stars across the heavens. Gradually he began to tell himself interesting stories about the earth and the sun and the moon. He had, of course, in primitive times very little knowledge of what was actually happening.

Since the very beginning, however, he has wanted to *know,* and before the days of scientific method, when he could not understand actual causes, he found it a simple enough expedient to invent explanations. Our interest in these explanatory stories, however, should be no less because today we know how ridiculous they are scientifically in view of our greater understanding. Such universe or world stories afford us fascinating glimpses into the mind of early man, while as myths or legends many of them are very beautiful indeed.

Some early theories

Up to the present time man in his great ignorance has been inclined, naturally enough, to conceive of himself as the center of the universe. His world, the earth, seemed to him to have been created for his particular benefit, and he simply took it for granted that the rest of the universe was so planned. To his unsophisticated reasoning it seemed that because he was the most important thing in the universe to *himself,* therefore he must of course *be* the most important thing—that for which the universe had been created, that about which the sun and moon and stars, even the heavens themselves, circled daily.

There are numberless legends and tales and folk-beliefs concerning the nature of the earth and the universe. The Egyptians, the Babylonians, the Scandinavians, the Chinese, the Mexicans, the American Indians—all peoples have evolved their own stories of the creation and nature of the earth and the universe.

One of the most ingenious theories probably originated with some race of people who lived on an island, or at least near the water. They saw the earth, or the portion of it that they knew, surrounded by water on all sides, and they came to believe that the earth floated in these waters. They also came to believe that water was the universal source or essence of all things.

Since the sun and the moon appeared to them as flat disks in the sky, their conception of the earth likewise was that of a flat disk which floated on the waters much as a leaf would float on the water of a pond. Furthermore, since they saw the leaves that floated on the surface of the pond send forth roots which stretched down and into the earth below the water, so they believed that the earth itself put forth roots which stretched down into the depths of the water below the earth. Through these "universe-roots" it was supposed that the earth drew up into itself the sustaining power from the universal waters.

These primitive people also observed that in the morning the sun rose right up out of the sea, and at night sank back into those same waters and disappeared until the following morning. What could be more natural, then, than to believe that during the night the sun was busily swimming through the water under the earth to get back to the other side so that it could rise again at the proper time and place?

The Vedic priests of India taught a variation of this idea. They thought that the earth was supported on twelve massive pillars and that it was flat, lying on these pillars as it would on a table. Of course, in this way only its upper side was habitable. The sun passed over the face of the disk-like earth during the day, and during the night it passed back again to the other side between the great pillars underneath.

An interesting conception held by the Hindus is that the earth has four foundations, one on top of the other. At the very base is a great, coiled world-serpent, which floats on the universal waters; on top of the serpent stands the great tortoise upon whose immense back rest four elephants which directly support the earth itself. These figures were supposed to be its actual physical foundation.

The earth supported by a whirlwind

The question of what supported the earth in space was always of great interest to ancient astronomers and philosophers. Many of the early thinkers agreed that the eternal waters supported the earth. Empedocles, a Greek poet and physicist who is credited with the discovery of the four elements, believed that the earth remained poised in space because it rested upon a whirlwind. And this whirlwind, as it rushed constantly around the earth, kept the heavenly bodies from falling down and destroying the earth. It was also the cause of the motion of the heavenly bodies—it blew them around the sky.

Anaxagoras, a contemporary of Empedocles, believed that the whirlwind had originally torn bits of matter from the earth and whirled them into the sky, thus forming the stars. Moreover, the stars, he believed, shone only by the friction caused by this great wind rushing past them. The sun, according to Anaxagoras, was an ignited stone or rock.

Anaximander, a Greek who lived in the sixth century B. C., was one of the first to realize that the pole star was the point about which the stars and the heavens themselves seemed to revolve. He believed also that the earth was at the center of the hemispherical dome of the sky—a flattened cylinder which had originally been surrounded by three envelopes—water, air, and fire. It still retained the envelopes of water and air, but the fiery envelope had been shattered and scattered to form the sun and stars. These were fastened to celestial circles in the sky and revolved with the heavens around the earth, which was believed to be the center of all things.

The Music of the Spheres

Pythagoras, another Greek philosopher, was the first thinker to understand the abstract nature of number. In experimenting with the science of numbers, Pythagoras and his followers evolved a fascinating theory of the universe. They believed that the intervals between musical notes corresponded to the distances between the planets, and that the five planets with the sun and moon formed a perfect musical scale, and these, with the celestial sphere—the perfect cosmic octave. Each heavenly body had a musical note of its own, and as the heavenly bodies moved in their orbits, all of these notes combined to produce that beautiful and unearthly music often referred to in literature as the Music of the Spheres.

One of the most fantastic theories was a modification of this original Pythagorean idea. Philolaus, another Greek, removed the earth from the center of the universe, where Pythagoras had placed it, and gave to it an orbit of its own. This left the most sacred place, the center of the universe, empty. Philolaus solved this difficulty by placing fire in the center—fire, the purest of the elements. But by giving the earth a movement of its own, Philolaus had upset the cosmic octave by adding to it another moving body. So long as the earth was motionless it was silent, but when it began to move it added its own note to the others. And now Philolaus was in a predicament. He had nine moving bodies, including the celestial sphere. This would never do, for seven (the original number of musical notes) was a sacred number, and so was ten, but nine was not so considered. So Philolaus, ingeniously, invented another planet, Counter-Earth or Antichthon. This made ten, and maintained the proprieties of the sacred numbers. No one had ever seen Counter-Earth, of course, but even this dilemma was not too much for Philolaus. He gave to Antichthon an orbit between the central fire and the earth, but since the earth always kept its habitable face from the central fire, no one ever could see this Counter-Earth.

Democritus, still another of the Greeks, believed in the early idea of the earth as a disk, but a disk resting in air rather than in water. He believed that the sun and moon were smaller than the earth, and that they had originally been like it but in colliding with our planet they had become partly absorbed and had lost their cores. Democritus also maintained that comets were formed when two planets approached each other closely, and that the Milky Way had once been the path of the sun before that body left it for a new course through the sky.

Astronomy and religion in Ancient Egypt

The ancient Egyptians worked out a comprehensive picture of the universe, albeit one which would not fit in with our scientific knowledge today. One of the greatest and most important of the Egyptian gods was Ra, the Sun-god. Many of the Egyptian deities were associated in some way with astronomical bodies—the Egyptians even considered the earth and the sky as gods. Because of this, it was an important part of their religious ritual that the movements of the heavenly bodies be noted most carefully—that the sun be observed at the exact moment of his appearance in the morning and his disappearance at evening, and likewise the movements of the moon and stars. And so, at a very early period, the priests of Egypt became her astronomers. Wherever there was a temple, to whatever god, there would be at least one priest, many of whose duties were astronomical in character. It is a rather compelling picture—these numberless temples scattered over Egypt and along the Nile, silent in the depths of the night, with the figures of their white-robed priests standing motionless upon the observation platforms or on the great pillars, their long garments blowing in the night wind as they observed the heavenly bodies which were portents for good or evil in their cosmology.

The Egyptian universe

The Egyptians believed that the universe was four-sided, with Egypt itself in the center. Egypt lay in the middle of a flat plain surrounded by enormously high mountains, with four higher mountain peaks at the four corners to indicate the cardinal points, and also to hold up the dome of the heavens. The sky was, to their minds, an iron ceiling over the universe, containing holes through which at night obliging gods let down the lamps of the sky—the stars—on cables, for the sole purpose of furnishing beauty and illumination for Egypt. In the morning these same gods pulled up the lamps, economically enough, and then the great God Ra, the Sun, started on his daily journey around the ramparts of the world, riding in his Nile chariot on the celestial river which flowed along the base of the mountain range and in which the Nile was believed to have its source.

The Egyptians believed sometimes that this boat in which the Sun-god sailed was a magic bark which navigated without hands or brain to steer it. At other times it was like one of the regular Nile boats, fully manned and equipped with a pilot in the prow and one in the stern, with a quarter-master, and half a dozen sailors.

At most times the boat of the Sun sailed along peacefully, but occasionally the great serpent, Apopi, who lived in the depths of the celestial river, would arise from the waters and attack the Sun-god. At such times the crew of his boat rushed to arms and sought in every way possible to overcome the dread monster—not only by arms but by the din of terrific noise. They beat and struck upon every conceivable instrument until at last Apopi, wearied and tired out, overcome by the magic of the gods, sank back again into the depths of the river, and the sun once more emerged. This, of course, was the Egyptian explanation of a solar eclipse.

The Babylonians had a similar idea of the universe as a box or chamber whose floor was the earth. In the center of this floor there was a high mountain peak, covered with snow, which they believed to be the source of the Euphrates River.

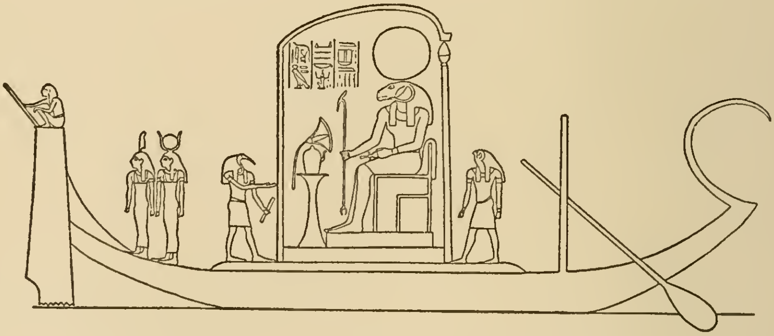
Other Egyptian beliefs

Another belief of the Egyptians was that the sun hatched daily from the Sun Egg, laid by a gigantic goose whose mate, the gander, daily announced this event by his loud cries at dawn. From this circumstance the Celestial Gander, sometimes known as Sibu or the Earth-god, was called the Great Cackler. Out of the Sun Egg came the bird which was the sun. According to some it was a heron, according to others a lapwing, or perhaps a sparrow hawk.

An ancient Egyptian tradition said that the earth and the sky were originally wedded gods, the Earth-god Sibu and the Sky-goddess, Nuit. From this marriage the Egyptians believed that everything came that ever has been or is or shall be. And then suddenly there came a new god, the god of air or sunshine, Shu, who came between Sibu and Nuit, the earth and the sky, and forced them apart. The goddess Nuit was forcibly pushed up into the region above the Earth-god and became the sky, and the God Shu remained forever between the Earth-god and his love, the sky.

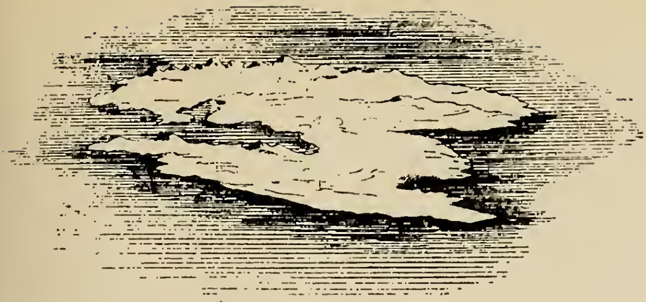
Another belief of the greatest antiquity, and one which also came out of Egypt, is known as Orphism. It was believed that there existed first great silent darkness everywhere, and that in time out of this primordial night there was born a World Egg which eventually divided into the skies and the earth. There are many variations of this belief, found among all races in their traditions and myths. One which is most commonly illustrated is that of the great World Serpent twined about the Earth Egg, warming and hatching it.

There are numberless interesting legends and early philosophies about the creation of the earth and the universe and the relation of one heavenly body to another. It seems to us that we have come a long distance from the time when man believed that the sun was swallowed by a dragon at times of eclipse, and that the world was originally an egg hatched by a serpent. But the most important thing is that we have come to understand that, as we acquire knowledge, our concepts change and we must adjust ourselves to new theories and new methods. Knowledge and understanding are what we seek. The real student of science is he who remembers that while we seem to have far outrun primitive and ancient man in our understanding of the universe, we must still maintain a real humility in the presence of the countless questions yet unsolved.



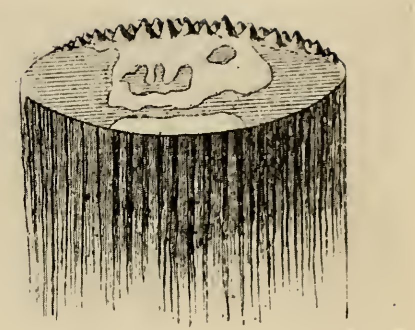
THE CELESTIAL BARQUE OF THE SUN-GOD

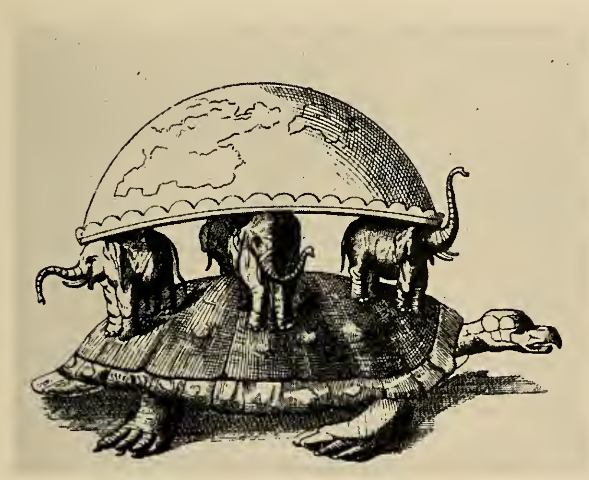
The Sun-god, with his attendant deities, is shown enthroned in his celestial barque. The Egyptians conceived of the Sun-god with the trappings and prerogatives of an earthly king



(Above) The flat disk of the earth lying in the eternal waters

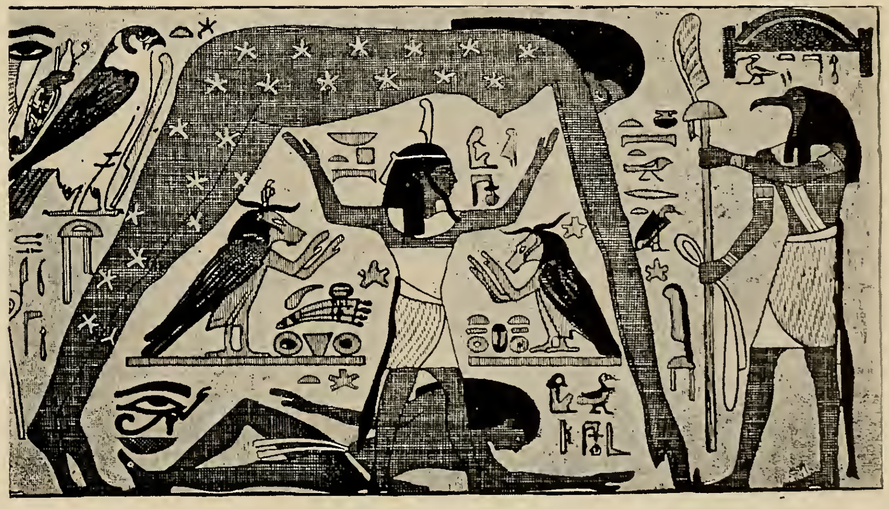
(Right) The earth with roots stretching down into the waters below

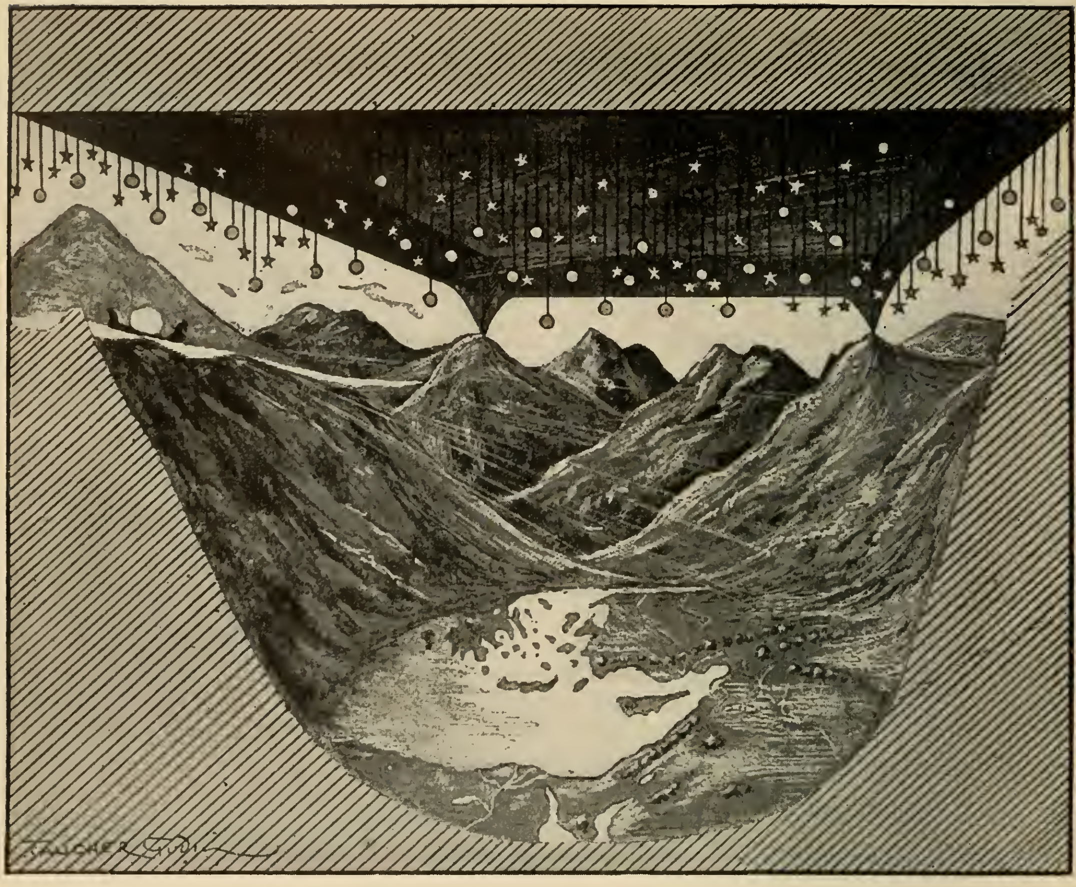




(Left) One Hindu conception of the foundations of the universe. Here the elephants and the tortoise alone support a hemispherical earth

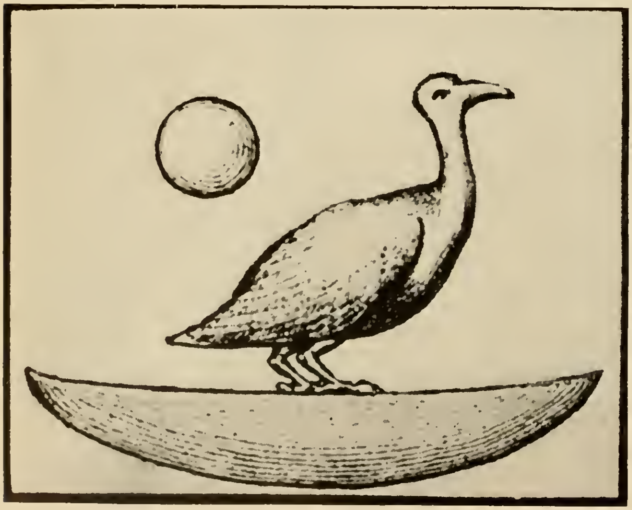
(Below) The Egyptian Earth-god Sibu separated from his mate, the Sky goddess Nuit, by Shu, the god of sunshine or air

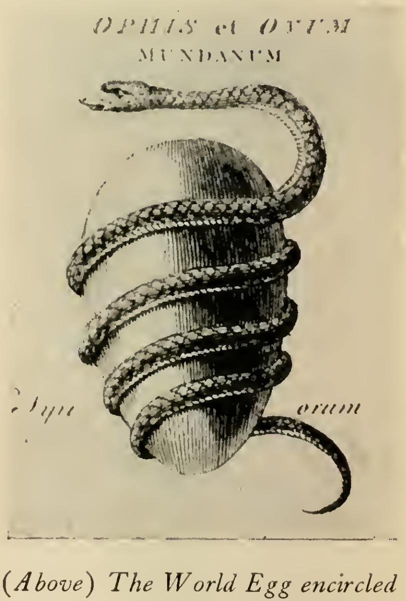




(Above) As early Egypt conceived of the universe. The Sun-god can be seen traveling along the celestial river in his river-chariot. Through holes in the sky "ceiling" hang the stars which the gods light and extinguish like lamps

(Below) The celestial goose which, so the Egyptians believed, laid daily the egg which hatched into the sun





(Above) The World Egg encircled by the great Earth Serpent whose warmth causes it to hatch

Glimpses into Relativity

A non-mathematical consideration of certain more or less obvious relations of the Einstein Theory of Relativity, with suggestions as to their importance in understanding the universe

By CLYDE FISHER

Curator of Astronomy and The Hayden Planetarium, American Museum

And from my pillow, looking forth by light
Of moon or favoring stars, I could behold
The antechapel where the statue stood
Of Newton with his prism and silent face,
The marble index of a mind forever
Voyaging through strange seas of thought, alone.

Wordsworth, THE PRELUDE,
Book third (Residence at Cambridge).

EARLY in the present century a new theory of space, time, mass, velocity, and gravitation was presented to the scientific world by a professor of physics in the University of Berlin, whose name has since become a household word. Einstein's Theory of Relativity, although admittedly difficult to understand, has intrigued the layman as well as the mathematical physicist and astronomer.

Soon after Einstein's Theory of Relativity had swept the scientific world, an address on the subject was presented before the American Association for the Advancement of Science, the largest and most important society of scientists in America. This lecture was given by Prof. Joseph Ames, head of the department of physics in Johns Hopkins University, and later president of that institution of learning. In the course of his discussion Professor Ames said: "It has been stated that only a dozen men in the whole world understand the theory of relativity, and I am not one of the twelve." Needless to say I, myself, am not able to increase that select number to a "baker's dozen."

At a dinner given in honor of Sir James Jeans on his recent visit to America, Sir James said that the only conception of the universe that can now be framed is a mathematical conception, and that after you have framed it, only a mathematician can understand it.

Prof. Edwin E. Slosson, in his *Easy Lessons in Einstein,* written soon after the theory of relativity had been announced, has given some encouragement for such an attitude. In a prefatorial dialogue between the author and a fellow commuter, who has just read in his morning paper something about relativity, the following conversation occurs:

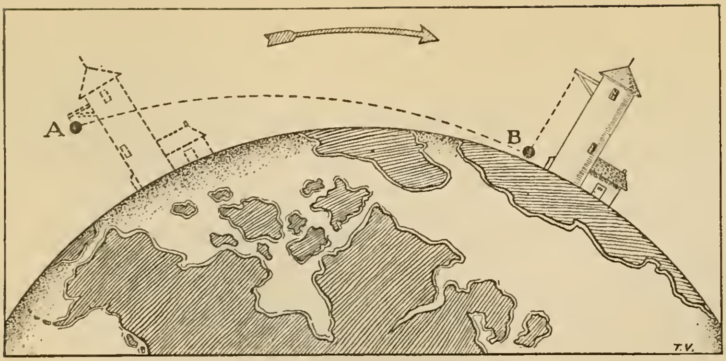
THE READER: "Can you tell me in plain language what it is all about?"

THE AUTHOR: "Yes. Just that. I can tell you what it is *about,* though I can't tell you what it *is.*"

It is of great interest to observe that the theory of relativity, though radically new, has been accepted by practically all physicists and astronomers of the world. The acceptance of relativity, perhaps not in its present form, but as a principle, is well-nigh universal. There are so few well-known physicists and astronomers who oppose it that one is reminded of the old saying that the exception proves the rule.

Newton considered space and time and mass and force as *absolute.* He looked upon gravitation as a force, but according to the theory of relativity this notion must be abandoned. As Bertrand Russell remarked, "Just as the sea does not cause the water to run toward it, so the sun does not cause the planets to move round it."

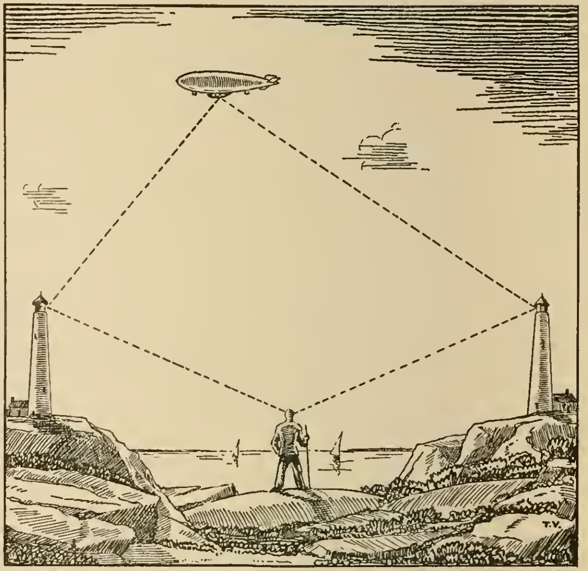
We have given up the notion of force, since it does not represent anything that is genuinely



DIRECTION IS RELATIVE

From the point of view of an observer in the tower, an object dropped from the top of it appears to fall in a straight line. We know, however, that the earth itself is constantly turning, and that if observed from a fixed position in space, the object would be seen to travel not in a straight line but in a curve. It might be said to drop straight toward the point on the earth directly under it, but that point is moving. Therefore, the actual path of the object is a curve, illustrated diagrammatically in this figure by the dotted line between A and B.

This illustration takes into account only one motion of the earth, namely its rotation on its axis



TIME IS RELATIVE

If lights are flashed from both towers at the same instant, the observer midway between sees the flashes simultaneously. But an observer in the airship overhead, being closer to the left-hand tower, would receive the flash from that tower sooner than from the other.

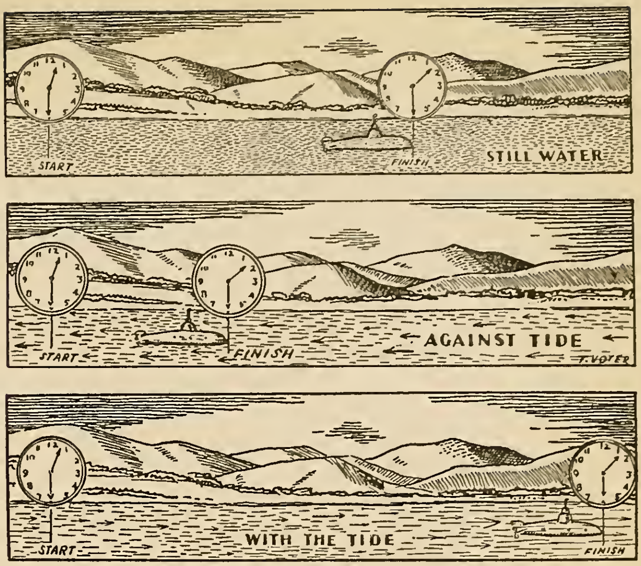
The speed of light is so rapid that the lag could not be detected by the eye; but that there is such a difference is obvious. We are all familiar with the lag between a flash of lightning and the bolt of thunder. The thunder seems to occur several seconds after the lightning, but this is only because the apparent time of their ocurrence is relative to the speed of light and sound respectively. Actually they occur in the same instant

---

to be found in the physical world. Although "force" is no longer to be regarded as one of the fundamental concepts of dynamics, but only as a convenient way of speaking, as Bertrand Russell points out, it can still be employed, like "sunrise" and "sunset," provided we realize what we mean. Often it would require very roundabout expressions to avoid the term "force."

The so-called "law of the conservation of matter" and the so-called "law of conservation of energy" of a former generation cannot now be held as true in a strict sense. Matter and energy are interconvertible. Mass increases with speed. Time shrinks or stretches depending upon the velocity.

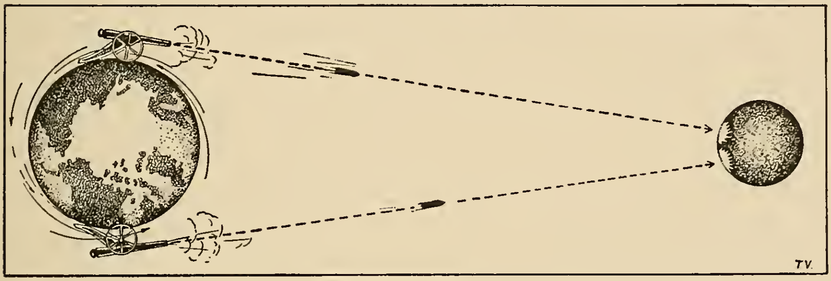
The name "relativity" therefore is applied to Einstein's theory simply because the primary



SPEED IS RELATIVE

Suppose that in each of these three drawings the submarine is being driven forward at the maximum speed of its engines. Its velocity with relation to the water is consequently the same throughout. But because the water itself may be moving, the speed of the submarine relative to the land is variable.

All three drawings show the distance traveled by the submarine in one hour. An observer not knowing about the tide would suppose that the motors were being run slower and faster. The speed of the craft relative to the land is not always the same



SPEED OF LIGHT, A STANDARD IN RELATIVITY

Because the speed of light is not altered by any movement of the medium through which it passes or by motion at the source, it serves as a standard of measurement.

In this diagram two shells are fired at the same instant from a pair of cannons on opposite sides of the earth. Because the earth is spinning, the lower shell travels faster than the upper, and reaches the moon approximately 166 hours sooner. The speed of rotation of the earth is in one case added to the speed of the shell, and in the other subtracted.

But this does not apply to light. Beams of light sent out from each of the cannons at the same instant arrive at the moon simultaneously, regardless of the movement of the earth. It is because the speed of light is not influenced by motion at its source or by motion of the medium through which it passes, that it figures prominently in the theory of relativity

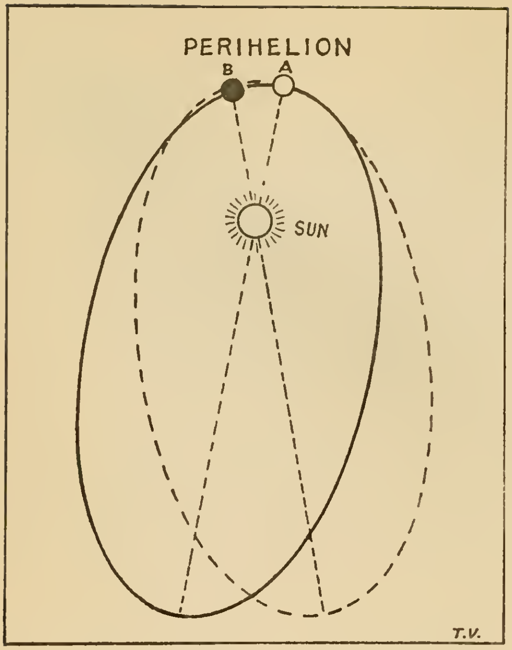
factors in astronomy such as direction, speed, size, and time are relative. Any one of these factors cannot be reckoned by itself, but only in relation to the others. The reader is referred to the simple examples of the relativity of direction, time, and speed illustrated herein.

For Einstein the old luminiferous ether does not function, and in the sketch that he draws of natural phenomena there is no mention of this hypothetical, imponderable, all-pervasive, and intermediate substance.

In his special theory of relativity (1905) Einstein did not include gravitation (accelerated motion) in his formulæ, but after ten years of study (1915), he incorporated this phenomenon in his general theory.

Prof. Henry Norris Russell of Princeton has summed up the matter as follows:

> The central fact which has been proved—and which is of great interest and importance—is that the natural phenomena involving gravitation and inertia (such as the motions of the planets) and the phenomena involving electricity and magnetism (including the motion of light) are not independent of one



MOVEMENT OF PERIHELION
POINT OF MERCURY

On successive revolutions around the sun the axis of Mercury's orbit turns. Represented diagrammatically, the end of the major axis moves in one year from A to B, in reality a distance of 43 seconds

another, but are intimately related, so that both sets of phenomena should be regarded as parts of one vast system, embracing all nature.

Eddington in *Space, Time and Gravitation* describes an imaginary experiment in which he supposes an aviator traveling at a speed of 161,000 miles a second relative to the earth. After making allowance for the time of transmission of light, there would still be a retardation in time. His cigar lasts twice as long as one of ours. But here reciprocity comes in because, in the aviator's opinion, it is we who are traveling at 161,000 miles a second past him; and when he has made all allowances, he finds that it is we who are sluggish. Our cigar lasts twice as long as his. Bertrand Russell, who accepts the validity of this supposed experiment, mischievously remarks: "What a situation for envy! Each man thinks that the other's cigar lasts twice as long as his own. It may, however, be some consolation to reflect that the other man's visits to the dentist would also last twice as long."

After correcting Newton, as has been remarked, it remained to correct Euclid, and it was in terms of non-Euclidean geometry that Einstein stated his new theory. According to the theory of relativity, it is believed that no complete description of an occurrence in nature can be made with the three coördinates of Euclidean geometry—length, breadth, and thickness—but that a four-dimensional space-time system must be conceived. Minkowski stated the essence of this conception in the following prophetic words: "Henceforth space by itself and time by itself shall sink to mere shadows, and only a union of the two shall preserve reality."

The question of infinity

Another question connected with the theory of relativity is whether the entire universe is infinite or finite. Twenty-five years ago perhaps most astronomers were inclined toward the idea that the universe is infinite. It was said that one could not imagine an end or an edge. And as yet there is no experimental evidence to prove that it is not infinite. Nevertheless, this theory has given the theoretical physicist some difficulty in his dealing with gravitation, and since the advent of relativity, there has been a swing toward the notion that the universe is finite.

The surface of a sphere has no boundary, yet it is not infinite. The universe may be shaped like a huge globe or sphere, and if so, there would be no end or edge. It is conceived as so huge that it would require time of the order of a thousand million years for light to travel around this possibly finite universe. And here is introduced the idea of curved space. There may be no straight lines about which we were taught in our Euclidean geometry. These supposedly straight lines may be arcs of great circles on this huge, though possibly finite, universe. As we know, things are not always as they seem. It may help in some of these apparently contradictory conceptions to recall the principles of perspective. When we look down a railroad track, the rails seem to converge, yet we know they do not.

As shown by Einstein, a finite universe is a necessary condition under the conception of a static universe. Under the modern conception of a non-static or expanding universe, however, he has shown that the universe may, or it may not be finite.

Einstein suggested *three* experimental tests which the astronomer could apply to the theory of relativity:

FIRST—The movement of the perihelion point of the planet Mercury (See figure on p. 238). After all the disturbances caused by the attraction of other planets had been taken into account, there still remained an unexplained perihelial movement of the orbit of Mercury. In other words, astronomers had found that the theory of Newton does not suffice to calculate the observed motion of Mercury with an exactness corresponding to that of the delicacy of observation attainable even three quarters of a century ago. In 1859 Leverrier found this unexplained perihelial movement to be 43 seconds in a century. This observation was corroborated in 1895 by Newcomb. The phenomenon had puzzled astronomers until Einstein explained it in 1915 by the general theory of relativity. He found that, according to his formulæ, this movement must really amount to just that much. At the time when he published his theory, this was its only experimental verification.

Einstein's explanation accepted

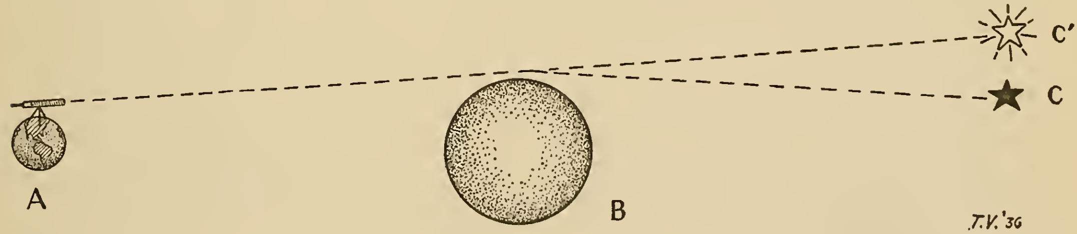
Immediately de Sitter, the great Dutch astronomer, accepted Einstein's explanation and confirmed the correctness of this astronomical test. Einstein stated that Professor de Sitter also contributed to the theory of relativity by showing that observations of the spectroscopic double stars prove that the speed of light is not dependent upon the dynamic condition of the source of light. Einstein stated further that Doctor de Sitter made great contributions in the relativity theory of the structure of space in the great cosmological problem.

SECOND—The bending of the rays of light from a star in passing the sun due to the gravitational pull of the sun (See pp. 239 and 241). This can be tested only at a total solar eclipse, when the moon comes between us and the sun and shuts off the overwhelming light of the sun, thus making it possible to photograph the stars in that portion of the sky in which the sun is located.

This effect was first observed under the direction of Prof. Arthur S. Eddington and others at the total eclipse of 1919, and has been observed at succeeding total eclipses of the sun.

A few months ago, H. Spencer Jones, Astronomer Royal, made the following interesting statement: "The British eclipse expeditions of 1919, which provided the first evidence in support of Einstein's conclusions as to the amount of deviation of rays of light in passing near the sun, would probably not have been sent out had de Sitter's papers not appeared." The papers here referred to were three in number, communicated by Doctor de Sitter in 1916-17 to the Royal Astronomical Society, shortly after the appearance of Einstein's paper on the generalized theory of relativity. Surely Doctor de Sitter had much to do with securing the general acceptance of the theory of relativity.

THIRD—The shifting of the spectrum lines of the sun toward the red owing to its own gravitational pull. This is entirely apart from the shifting due to the motion of a heavenly body either toward or from us. In accordance with this latter principle, it has long been known



LIGHT RAYS ARE BENT BY GRAVITY

According to one of Einstein's principles, rays of light are bent by the gravitational pull of any large heavenly body close to which they pass. Light rays coming from the star C are bent toward the sun (B) when passing near it, so that an observer on the earth (A) sees the star in the direction of C′ instead of in its true direction that, when a star is approaching us, there is a shift of the spectrum lines toward the violet, and when the star is receding, there is a shift toward the red. By applying this principle it has been possible to go further and calculate the velocity of approach or recession of a heavenly body. Also, by observing and comparing the shift on one side with that on the other, it has been possible to prove that certain heavenly bodies and systems rotate. This shifting due to the approach or recession of a heavenly body is known as the Doppler effect, and it may be better understood by comparison with a familiar, analogous phenomenon in sound.

The Doppler effect

If one stands by a railroad track when a locomotive is passing with the bell ringing or the whistle blowing, he will note an abrupt change in the pitch of the bell or the whistle as the locomotive passes him. When the locomotive is approaching the observer, the pitch will be higher than when it is just passing him, and after the locomotive has passed by the pitch will be lower than when it was passing him. The slur in pitch as the locomotive passes is very noticeable. Since pitch varies with the number of vibrations that strike the ear per unit time, it is evident that this marked change is due to the piling up of vibrations while the locomotive approaches, thus causing more vibrations to strike the ear per unit time—producing a higher pitch—and the stringing out of the vibrations when the locomotive is receding, thus producing a lower pitch after the locomotive has passed.

In the case of light, when a heavenly body approaches, there is an increased frequency of the waves of light, or, in other words, the wave-length is shortened, which causes a shift of the spectrum lines toward the violet; when the body is receding, there is a decreased frequency of the light, or an increase in the wave-length.

Aside from the Doppler effect there is, according to Professor Einstein, a slight shift of the spectrum lines of the sun toward the red. And this has been proved experimentally by the late Dr. Charles E. St. John at the Mt. Wilson Observatory.

And there has been a further confirmation of this effect in the case of the dense companion of Sirius. This star is believed to be so dense that one cubic inch of it brought to the earth would weigh nearly a ton, i.e. two thousand times the weight of platinum, our planet's heaviest known substance. On account of the greater gravitational potential of this exceedingly dense star, it was calculated that the shift here would be twenty-seven times as great as on the sun, and this was confirmed by actual test by Dr. Walter S. Adams, director of the Mt. Wilson Observatory.

The latest confirmation of this test was reported last April before the annual meeting of the National Academy of Sciences in Washington. Dr. Robert J. Trumpler described his six years' work at the Lick Observatory, consisting of observations of Class O stars, the hottest, most luminous, and at the same time the most massive stars in the universe. They reach a mass 180 times that of our sun, and their surface temperatures are 40,000 degrees Centigrade as compared with 6000 degrees for the surface temperature of our sun.

Radial velocity

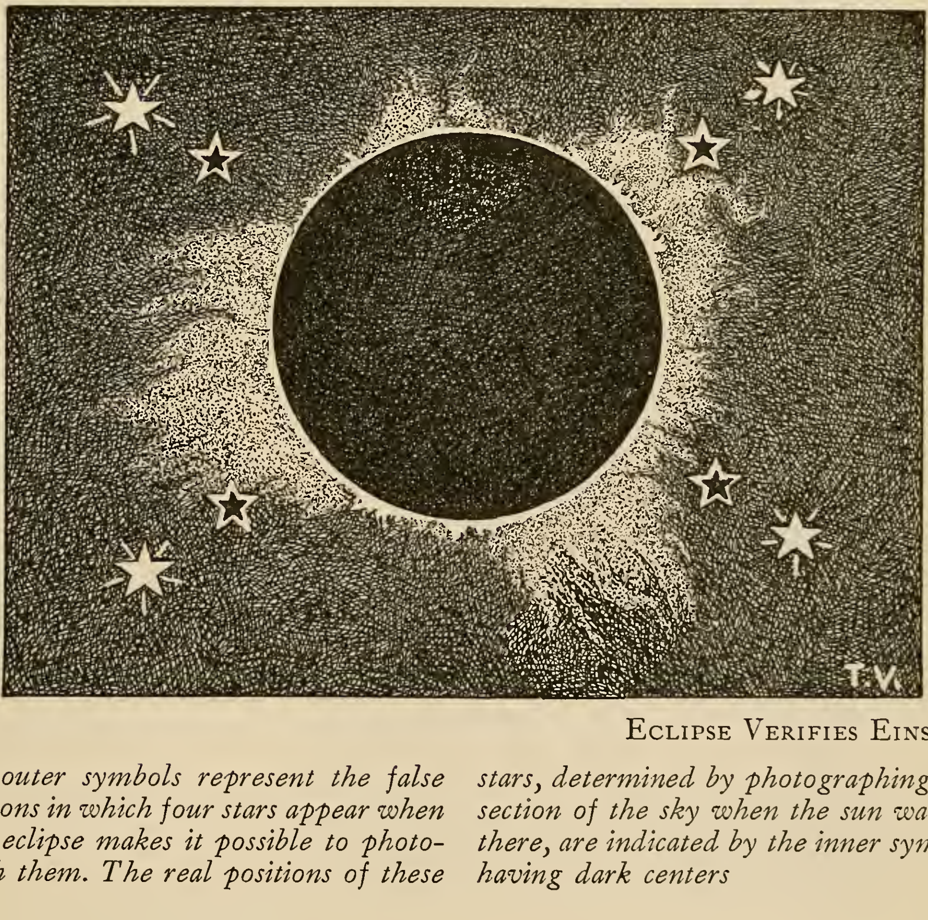
Fortunately for the astronomers, many stars of Class O occur in clusters in the Milky Way, Doctor Trumpler stated, and in this investigation he studied nine such Class O stars in six different star clusters. The stars of such a galactic cluster form one physical system and thus all the star members of the cluster must have nearly the same motion. Yet, while all the stars in a cluster have the same true motion, those which have higher luminosity, and higher temperature and mass, show a radial velocity greater than the smaller, fainter, and colder stars in the cluster system.

The excess in radial velocity of the more massive and luminous stars, namely, the O type stars, cannot be due to the Doppler effect, Doctor Trumpler reasoned, since the actual motion of the O stars cannot be greater than the motion of the fainter stars in the same cluster. The excess, therefore, in the observed velocity of the O stars, an excess which reveals itself by a shift toward the red in the spectra, must be due entirely to the red shift predicted by relativity.

In the opinion of one of our leading American astronomers, Dr. W. W. Campbell, formerly director of the Lick Observatory and more lately president of the University of California, all three astronomical tests of the Einstein Theory of Relativity have been satisfactorily met.

In a recent address Dr. Robert A. Millikan, of Cosmic Ray fame, who was awarded the Nobel Prize in Physics in 1923, stated:

> I wish to dispel a very common misconception, since the average man, who only knows science from afar, labors, I suspect, under the misunderstanding that we honor Einstein only because he was the author of the theory of relativity.
>
> Now, every physicist knows that the Nobel prize committee, which awarded him that honor in 1921, did not have to consider the theory of relativity at all in making that award. They might have given it on any one of at least four grounds, and the scientific world would have been unanimous in applauding the award on any one of them. I myself have the best of reasons for knowing which one of these four they actually chose. The late Professor Gullstrand, the chairman of the Nobel committee in making the 1923 award, stated that it was the experimental verification of the Einstein photo-electric equation that removed all doubt as to its validity in the minds of the committee, so that they chose the first theoretical statement of that equation in 1905 by Professor Einstein as the basis of the award to him in 1921, and the experimental verification thereof as the half basis of the 1923 award. Now, this equation has nothing whatever to do with relativity, but I think that all students of modern physics will agree that it is of quite as far-reaching significance as is relativity, or, indeed, as is anything that has appeared in modern physics, for it necessitated, as soon as it was firmly established, our return to at least a semi-corpuscular theory of the nature of radiant energy.
>
> The extraordinary penetration and boldness which Einstein showed in 1905 in accepting a new group of experimental facts and following them to what seemed to him to be their inevitable consequences, whether they were reasonable or not as gauged by the conceptions prevalent at the time, has never been more strikingly demonstrated.
>
> Any small contributions that I myself have made to the progress of physics have been largely in the nature of experimental verification of predictions contained in three theoretical equations first set up by Einstein, and but one of these has had anything to do with relativity.
>
> The first of these was the Brownian movement equation (1905) whose verification by a number of observers removed the last doubts as to the atomic theory of matter; the second was the aforementioned photo-electric equation (1905) which changed rad-



ECLIPSE VERIFIES EINSTEIN

The outer symbols represent the false positions in which four stars appear when total eclipse makes it possible to photograph them. The real positions of these stars, determined by photographing that section of the sky when the sun was not there, are indicated by the inner symbols having dark centers

> ically our conception as to the nature of radiation; the third was the equation expressing the interconvertibility of mass and energy. This grew out of special relativity (also 1905) and it has recently predicted for me verifiable relations in the radioactive field, and it also constitutes the most important basis for the cosmic ray conclusions that I am now wishing to draw. All these three are of equal significance, I think, with the predictions from general theory of relativity . . . . .
>
> You can throw general relativity into the wastebasket if you will, and *Professor Einstein's position as the leading mind in the development of our modern physics would still remain unchallenged.*

On the same occasion an address was delivered by the late Prof. A. A. Michelson, inventor of the interferometer, the only instrument with which we can measure the diameter of the stars, the instrument that made possible the Michelson-Morley experiment on ether-drift. Professor Michelson, the first American to receive the Nobel Prize in Physics (1907), expressed himself as follows:

> I consider it particularly fortunate for myself to be able to express to Doctor Einstein my appreciation of the honor and distinction he has conferred upon me for the result which he so generously attributes to the experiments made half a century ago in connection with Professor Morley, and which he is so generous as to acknowledge as being a contribution on the experimental side which led to his famous theory of relativity. I may recall the fact that in making this experiment there was no conception of the tremendous consequences brought about *by the great revolution which Doctor Einstein's theory of relativity has caused—a revolution in scientific thought unprecedented in the history of science.*

To refer again to Professor Millikan's mention of our return to at least a semi-corpuscular theory of the nature of radiant energy, the following conclusions on this subject, made by Prof. Arthur H. Compton, third American winner of the Nobel Prize in Physics, are illuminating:

> Perhaps the best picture that one can give of the relation between waves and particles is the analogy of sheets of rain which one sometimes sees in a thunderstorm. We may liken the waves to the sheets of rain that one sees sweeping down the street or across the fields. The radiation particles would correspond to the rain drops of which the sheet is composed.
>
> How then does the matter stand? The tangible objects with which we are familiar we find constituted of molecules. These, in turn, are composed of atoms and these of positively charged and massive protons and the negatively charged and mobile electrons. The light which makes plants grow and which gives us warmth has the double characteristics of waves and particles, and is found to consist ultimately of photons.

A few years ago Dr. Frederick C. Leonard, professor of astronomy in the University of California, was asked to prepare a list of the ten greatest astronomers of all time, arranged in the order of their greatness, with reasons for his choice. The article was published in *Popular Astronomy* for November, 1930. Newton's name heads the list, and there is only one living person included in the ten and that is Einstein. Here is Professor Leonard's list in the order in which he gave it: Newton, Copernicus, Galileo, Kepler, Einstein, Hipparchus, Herschel, Kirchhof, Ptolemy, and Tycho.

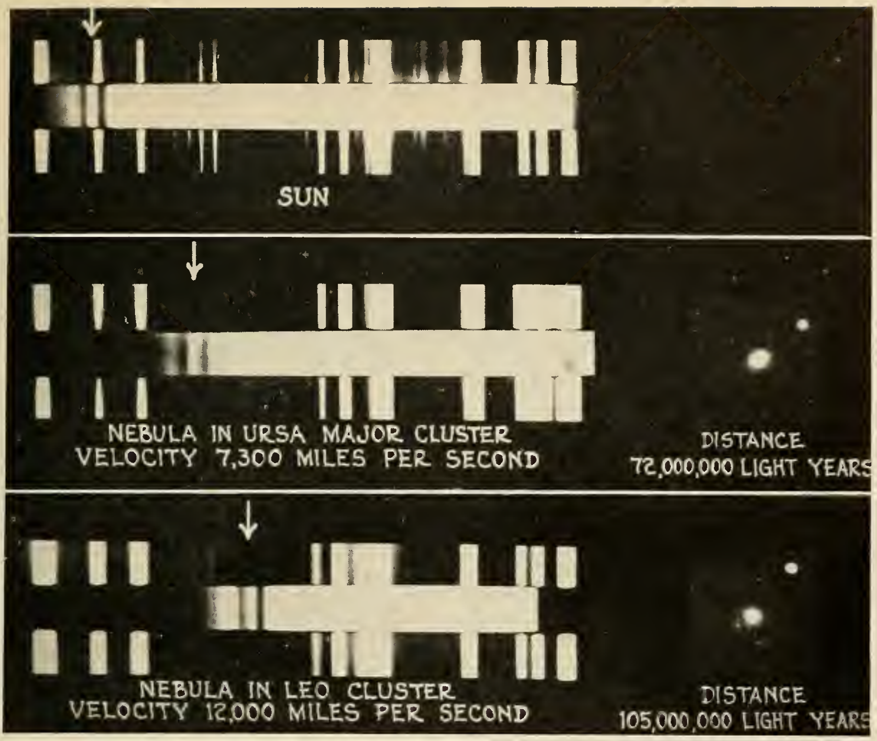
Professor Eddington stated the matter thus:

> When Einstein overthrew Newton's theory, he took Newton's plant, which had outgrown its pot, and transplanted it into a more open field. All this new growth of science had its roots in the past. If we see farther than our predecessors, it is because we stand on their shoulders.

It is manifestly unfair to say, as we sometimes hear it, that Einstein has destroyed Newton, for every great creative scientist builds on the work of those who have gone before. Kepler built on the work of Tycho Brahe. Without Galileo and Kepler there would have been no Newton. And Einstein has extended the work of Newton and the other titans who preceded him. When Lord Haldane introduced Einstein's lectures in Kings College, he said to the audience, "You see here before you the Newton of the twentieth century, a man who has called forth a greater revolution in thought than even Copernicus, Galileo, or Newton himself."

In his work, Einstein has always given full credit to his predecessors, and he has been equally generous with his contemporaries, among whom he especially mentions Lorentz, Minkowski, Michelson, and de Sitter.

There is still much misunderstanding in lay circles concerning the theory. The word *relativity* is still confused with the word *relativism*. All who have dipped into relativity at all, however, know that it cannot be understood without the mathematics for it is essentially a mathematical theory. It may, however, be possible without mathematics to arrive at some notion of what it is all about.



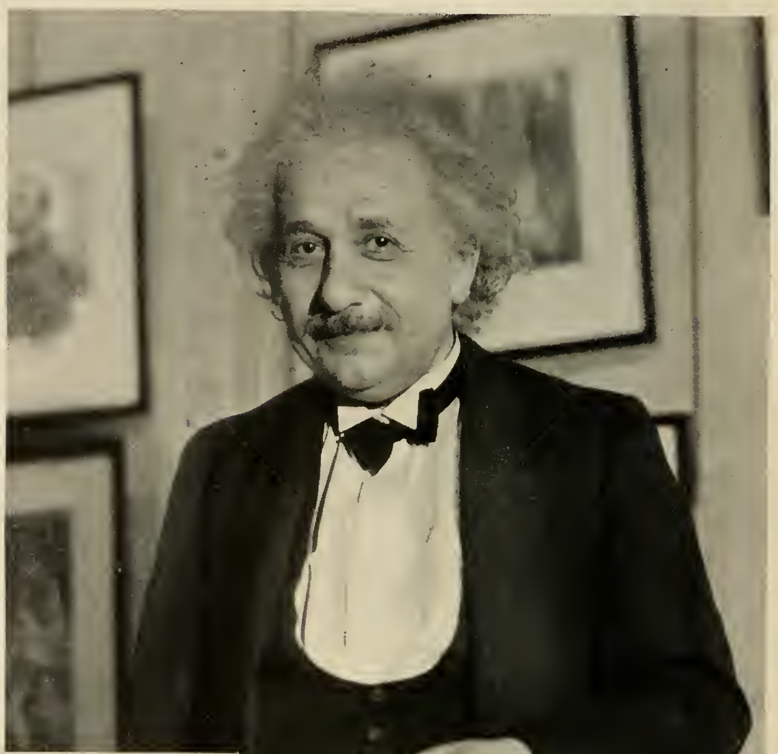
Courtesy of Mt. Wilson Observatory

Shift of spectrum lines toward the red. The shift of the spectrum lines of these nebulæ toward the red is interpreted as due to their motion away from us, and is known as the Doppler effect. As described on pp. 240-241, there is, according to the theory of relativity, an additional shift toward the red in light from the sun and other massive bodies, exactly like this in character, due to the gravitational potential of the body

The Einstein Tower. This Solar Tower, like those at Mt. Wilson and at Arcetri, Italy, was constructed for the purpose of studying the sun. At Potsdam an important object was the study of the Einstein shift in the spectrum of the sun

Photo by Courtesy Astrophysical Observatory at Potsdam

Informal Glimpses of Exponents of Relativity



Photograph by Clyde Fisher

Professor Albert Einstein, author of the Theory of Relativity, and member of the staff of the Institute for Advanced Study at Princeton

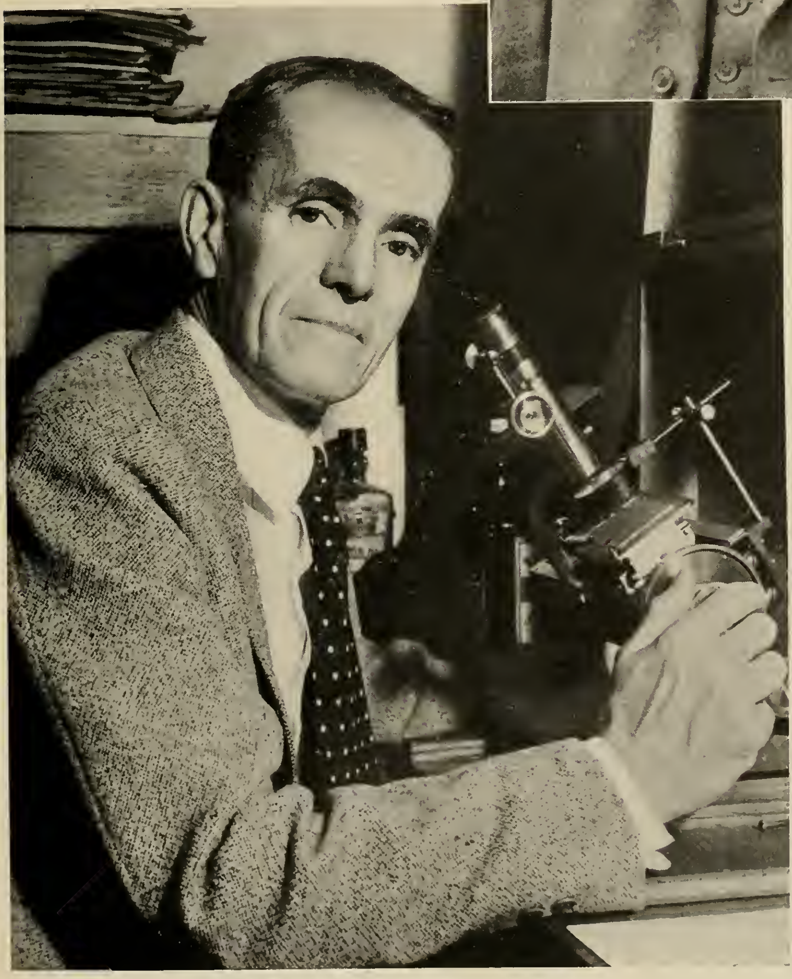
Professor Einstein proving the Principle of Equivalence in a lecture before the American Association for the Advancement of Science, December 28, 1934, in Pittsburgh. Matter and energy are interconvertible

Photograph by Keystone View Company

(Right) Sir Arthur S. Eddington, Plumian Professor of Astronomy and Director of the Observatory at Cambridge University, who directed the first investigation of the second astronomical test of relativity at the 1919 total eclipse of the sun. (See p. 239)

Photograph by Clyde Fisher

(Below) Dr. Walter S. Adams, Director of the Mt. Wilson Observatory, who by observation confirmed the Einstein shift toward the red in the spectrum of the dense companion of Sirius. (See p. 240)

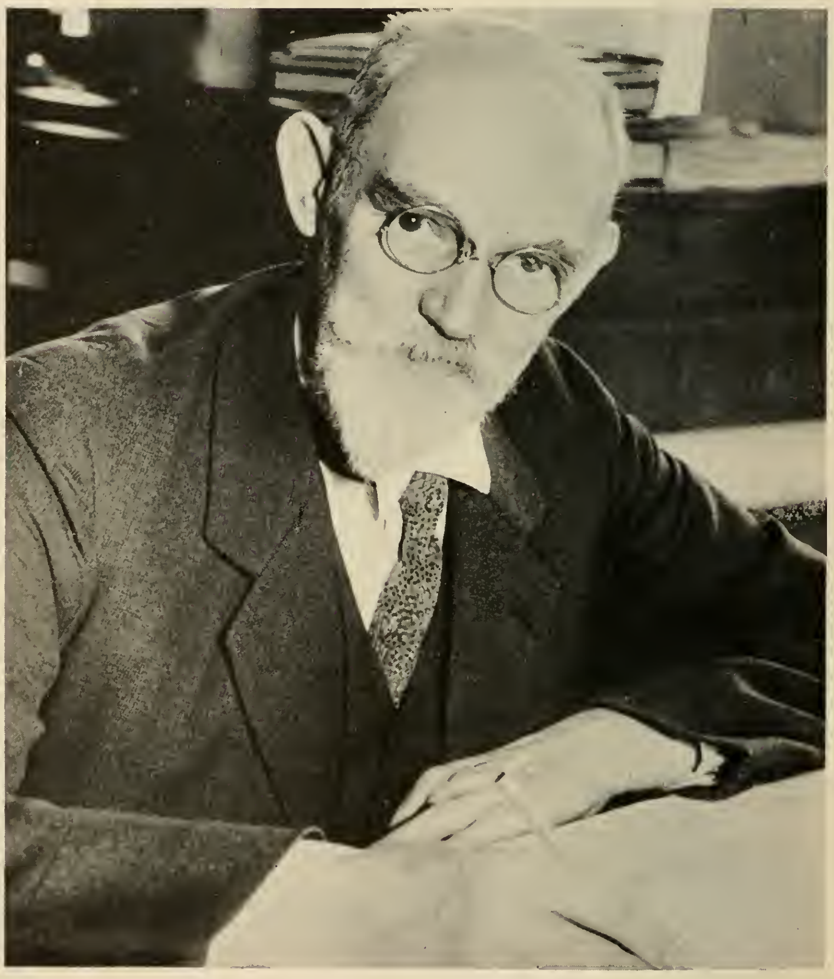


Courtesy of Wide World Photos

(Left) Dr. Henry Norris Russell, Research Professor of Astronomy and Director of the Observatory at Princeton University, who has promoted the general acceptance of the Theory of Relativity by his lucid discussions

(Below) The late Professor Willem de Sitter, former director of the Leyden Observatory. This brilliant Dutch astronomer has probably done more than any one, except Professor Einstein himself, to establish the Theory of Relativity

Photograph by Clyde Fisher



Courtesy of Wide World Photos

The Calendar Through the Ages

Complications in the measurement of time that have beset man from ancient times to the present day

By FREDERICK SLOCUM
Wesleyan University,
Middletown, Conn.

IN a cemetery in Middletown, Connecticut, is this epitaph:

"In memory of Mr. Nath'l. Goodwin who was born in Boston, Feb. ye 24th 1672/3, departed this life March ye 7th, N.S. 1753, upon his birthday, being just 80 years old."

That reads like a paradox—born February 24, died March 7, upon his birthday—but it simply means that there had been a change in the calendar during his lifetime. The "N.S." in the epitaph stands for New Style of reckoning dates.

This is only one of many changes that have been made in the calendar, and still further revision is now being actively discussed.

Genesis i. 14, reads:

"And God said, Let there be lights in the firmament of the heaven to divide the day from the night; and let them be for signs, and for seasons, and for days and for years."

The writer should, of course, have put "for days, *for months*, and for years." These three are the units of time upon which most calendars have been based. These are natural units, being measures of the rotation of the earth on its axis, the revolution of the moon around the earth, and the revolution of the earth around the sun. In addition the calendar contains artificial units, such as weeks, hours, minutes, and seconds.

The use of the year as a measure of time is referred to in the very earliest writings, but its universal adoption in a calendar began in the first century B. C. Prior to this time many different types of calendar were used by the various nations. They were developed chiefly in connection with religious festivals and were, in general, under the control of the priests. As many of these rites were associated with the moon, some of the calendars were based upon the month, but since the dominating factor in all primitive life was the changing seasons, the year, too, played a prominent part as a calendar unit.

Babylon, Assyria, Egypt, and China had calendars as early as from three to five thousand years before Christ. In Central America the ancient Maya civilization produced its own complicated but accurate calendar at a not much later date.

Regulating the seasons

The chief difficulty with most of the early calendars is the incommensurability of the month and the year. In most countries the month was reckoned from the first appearance of the crescent moon, an event greeted by the priests with prolonged blasts of trumpets. From one crescent moon to the next is about 29.6 days and twelve of these intervals would amount to 355 days, whereas the year, as measured by the apparent motion of the sun, is 365 days. In such a calendar, in order to keep the seasons always in the same months of the year, it would be necessary to add a few days from time to time, or, to use the technical phrase, to make an intercalation.

According to Cicero, the Greeks were in the habit of adjusting their calendar when it appeared to be in error, by lengthening or shortening a month. In Aristophanes' play, "The Clouds," the moon is represented as scolding the Athenians on account of the confusion in their calendar, and the consequent errors in the dates of the festivals. When the gods were mourning, the Athenians were making merry; and when the Athenians ought to be sacrificing to the gods, their courts were in session and their men were transacting routine business.

Sometimes, apparently, the calendar fell into disorder from ignorance, or from the unskillful way in which the intercalations were made, but, at times, it was undoubtedly deliberately juggled for some special purpose such as to increase or shorten a term of office or to add to the number of revenue payments.

When Julius Cæsar came into power, he found the Roman calendar in great confusion, and proceeded, with the aid of the Egyptian astronomer Sosigenes, to rectify this inconvenient state of affairs.

January 1 becomes New Year's Day

First of all, he decided to ignore the phases of the moon and to base the calendar upon the year as determined by the revolution of the earth around the sun, or, what amounts to the same thing, by the apparent motion of the sun around the earth. This was assumed to be 365¼ days. He retained the idea of dividing the calendar into months, but increased the number of days in them to produce the right total. The first month of the year at that time was March, and December, as the name implies, was the tenth. Cæsar changed the beginning of the year to January 1st, and made that date fall shortly after the winter solstice, probably, in that particular year, at the time of the new moon next following.

Most of the old names of the months were retained, but Quintilis, the fifth month counting from March, was changed to July, for Julius, to commemorate the revision. Later, Sextilis was changed to August by Augustus Cæsar.

Since the calendar must contain an integral number of days, it was decreed that, in order to take account of the fraction ¼, there should be three consecutive years of 365 days followed by one of 366 days, the extra day being added at the end of February.

The seven-day week was also retained in the calendar of Cæsar. The origin of the week is not known with certainty, but it probably was connected with religious festivals. This seven-day period was used by the early Chaldeans, Egyptians, and others, and the days of the week were, in nearly all cases named for what were known as the seven wandering stars, viz., sun, moon, and the planets Jupiter, Saturn, Mars, Venus and Mercury. The names that we now use have come down to us through the Anglo-Saxons. Their name for Jupiter was Thor, whence our Thursday. Mercury was Woden; Mars, Tues; Venus, Friga; etc.

The effect of religious festivals

The Julian Calendar was put into effect in the year 709 of the Roman Era, which corresponds to 45 B. C. in our present method of reckoning. Most of its details were soon adopted by nearly all the civilized world. In a few countries, notably in England, the date of the Vernal Equinox was retained as the beginning of the year. It was not until the sixteenth century that any change was deemed necessary. The revision then undertaken was due to the fact that some of the religious festivals were gradually changing with respect to the seasons. For example, at the Council of Nicæa, held in 325 A. D., Easter was defined as the Sunday following next after the date of the full moon which occurs on or next after the date of the Vernal Equinox. In that year, 325 A. D., the date of the Vernal Equinox was March 21, but by the time of Pope Gregory XIII, 1582, it had worked forward to March 11. The reason for this is that the tropical year, that is, the year of the seasons, reckoned from equinox to equinox, is not exactly 365¼ days, or 365 days and 6 hours, but is 365 days, 5 hours, 48 minutes, and 46 seconds. This difference of $11^m\ 14^s$ between the year of the Julian calendar and the correct tropical year amounts to one whole day in 128 years.

Pope Gregory ordered that ten days be dropped from the calendar to bring the date of the Vernal Equinox back to March 21, and in order to keep it there, instead of decreeing that one leap year should be omitted every 128 years, he decided that three should be omitted every 400 years, which amounts to nearly the same thing. Thus he amended the Julian rule so that February would have 29 days on every year that is divisible by 4, *except* those century years that are *not* divisible by 400. Thus the years 1700, 1800, 1900 were not leap years.

This Gregorian calendar was adopted in Roman Catholic countries in 1582, but it met with great opposition in all parts of Europe that were not under the Papal supremacy. It was not until 1752 that the British Parliament finally voted to make the change. They decreed that eleven days should be omitted between September 2 and 14. This caused rioting on the part of the general populace, who assumed that they were being robbed of that much time, and many churchmen were scandalized at the idea of deliberately changing the dates of the holy days.

The decree of Parliament also provided for moving the beginning of the year from March 25 to January 1, and for the adoption of the "New Style" of reckoning in all the colonies. For many years previous to this it had been the custom in Great Britain to recognize the Gregorian calendar by writing two numbers for the year between January 1 and March 25. For example, in the quoted epitaph, February 24, 1672/3, means that it was still 1672 in England, but according to Rome, 1673 had begun on the previous January 1.

Making use of leap years

Under the Gregorian rule for leap year, the date of the equinox will change only one day in 3000 years. Russia, Greece, and other countries in which the Eastern Orthodox Church held sway, adhered to the Julian calendar until 1923, when they adopted a scheme which is even more accurate than the Gregorian, namely, that century years shall be leap years only in case their numbers, when divided by 9, give a remainder of 2 or 6. This is equivalent to omitting seven leap years every nine hundred years.

Either of these rules is satisfactory for maintaining the seasons in a fixed place, but there are other factors in the calendar which make it far from ideal. For example: the months range in length from 28 to 31 days; the number of business days in any month varies; there may be either 4 or 5 Sundays in a month; the year, as well as the month, may begin with any day of the week; holidays of fixed date, like December 25, February 22, and July 4, may fall on any day of the week; Easter may fall on any date between March 22 and April 25.

To remedy these difficulties various schemes have been proposed, many of which have recently been under discussion by a committee appointed by the League of Nations to consider revision of the calendar. The two plans that met with the most favor are for fixed calendars, the same for every year, except for the leap day.

Two new plans

One arrangement retains the twelve months but makes every third month 31 days long; the other nine, 30 days each. This adds up to 364 days, or 52 weeks. Each quarter would consist of three months, or 91 days or 13 weeks, beginning on a Sunday and ending on a Saturday, exactly the same for every year. The 365th day would be called New Year's Day, and would not be counted in any week or in any month. In the case of a leap year, an extra day would be inserted before July 1. It is proposed also to define Easter as a fixed date, possibly April 8.

The other plan is to divide the year into thirteen months of 28 days or four weeks each. This also would necessitate considering New Year's Day and Leap Day as extra days. Thus every month would be exactly like every other month, but the year could not so easily be divided into halves and quarters.

In all the calendars mentioned above, the days are counted, but neither the day itself nor its subdivisions are specifically defined. Among the early Greeks and Romans the daytime was divided into twelve hours, and the night into a like number of hours. The length of such hours would vary from summer to winter. We still follow the custom of using twice twelve hours, but now they are fixed in length. The earliest timepieces were some form of sundial for the daytime, and a sand clock, a clepsydra (water clock), or a candle or a lamp for marking the hours during the night.

Cæsar, in his Commentaries on the winter campaign to Great Britain, states that the water clocks froze, throwing the night watches into great confusion.

During the seventeenth century accurate clocks and watches were made and these were adjusted to keep *mean solar time*, by which is meant a uniform fictitious time which may be explained thus: The apparent solar day, as reckoned from noon to noon, varies in length throughout the year. This interval is due not only to the rotation of the earth on its axis, but also to the motion of the earth in its orbit around the sun. Since the orbit is an ellipse, the earth's distance from the sun varies, with a corresponding variation in the gravitational pull of the sun on the earth, and, as the speed of the earth in its orbit depends upon this pull, the apparent solar days must vary in length. A still further irregularity is due to the fact that the plane of the earth's orbit is inclined about 23½° to the plane of the equator as determined by its rotation.

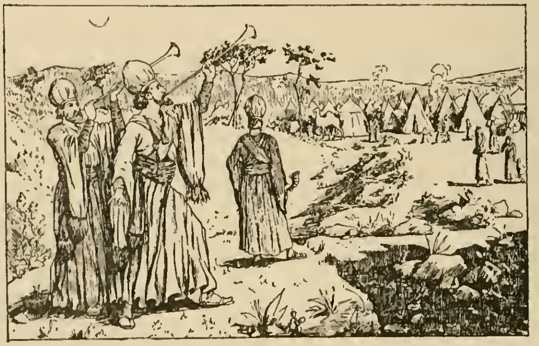
A universal time measure

To obviate the irregularities of apparent solar time, a fictitious sun is imagined to move along the celestial equator at a uniform rate, equal to the average rate of the true sun. Time kept by this fictitious sun, called mean solar time, is now universally used.

All kinds of time are intimately connected with the longitude of the place from which the time is reckoned, so the longitude is frequently expressed in time units as well as in angular units. Thus 360° would correspond to 24 hours, or 15° to one hour. The sun in its apparent daily motion is, of course, always moving westward, so when it is noon at Greenwich, for example, it is 1 P. M. at a place 15° east of Greenwich and 11 A. M. at a place 15° west of Greenwich.

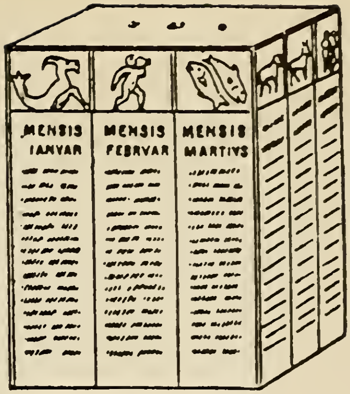
Prior to 1883, each town kept time reckoned from its own local meridian. New York time was less than Boston time by $11^m\ 31^s$ and greater than Washington time by $12^m\ 22^s$. No two places kept the same time unless they happened to be on the same meridian. This caused no great inconvenience until the coming of the railroads, telegraph and telephone. With a wider spread of commercial interest, it was found necessary to adopt a standard time for relatively large areas. In general, all places within 7½° of a meridian which is a multiple of 15° reckoned from Greenwich, keep the time of that meridian. Thus the United States has four time belts. The first extends from the Atlantic Coast to a line running from eastern Michigan to western Florida. This area normally keeps the time of the 75th meridian, or Eastern Standard Time. The next belt extending westward to a line from North Dakota to Texas keeps 90th meridian time; the Rocky Mountain region, the time of the 105° meridian; and the Pacific coast states, the time of the 120° meridian. In some parts of the country during the summer, where the so-called Daylight Saving Time is used, the clocks are set ahead one hour, which is equivalent to using the standard time of a meridian 15° farther east. Thus in winter New York keeps the time of the 75th meridian and in summer the time of the 60th meridian.

The determination and distribution of accurate time is a job for the professional astronomer. On every clear night some member of the staff of the U. S. Naval Observatory observes with a transit instrument a number of stars as they cross the meridian of Washington. From his observations he deduces the time that the fictitious mean sun would indicate at the various standard meridians. This is the time that is broadcast by means of the radio at intervals during each day.

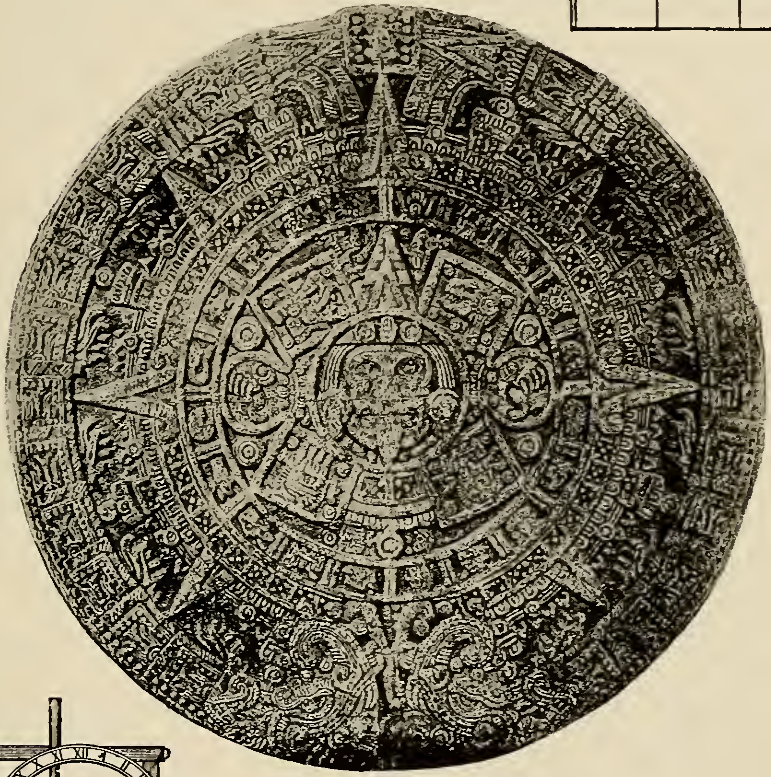


Ceremony of the New Month. The Jews announced with a blare of trumpets the coming of the new month, which began when the thin crescent of the new moon was first visible. (From "Astronomy of the Bible" by E. W. Maunder)

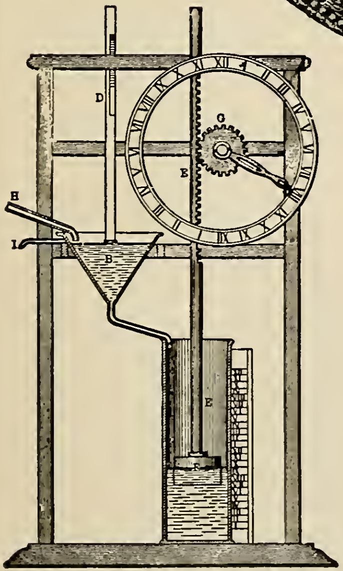
Man's Timekeeping — Past and Present



Harking back to the days of Cæsar: A Roman calendar in which the months, with their zodiacal signs, were conveniently arranged on the four sides of a tablet

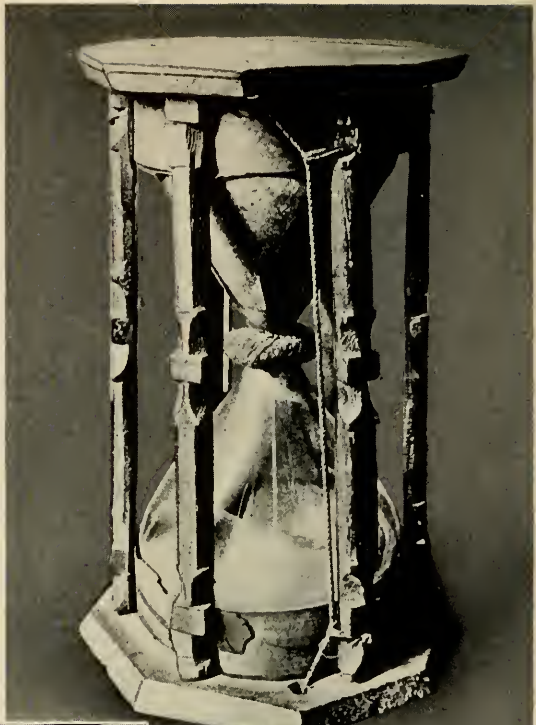


The Calendar Stone, the most famous of Aztec monuments, not only represents the sun's face, with the divisions of the year, the days of the month, the points of the compass, but also the creation myths of the Aztecs

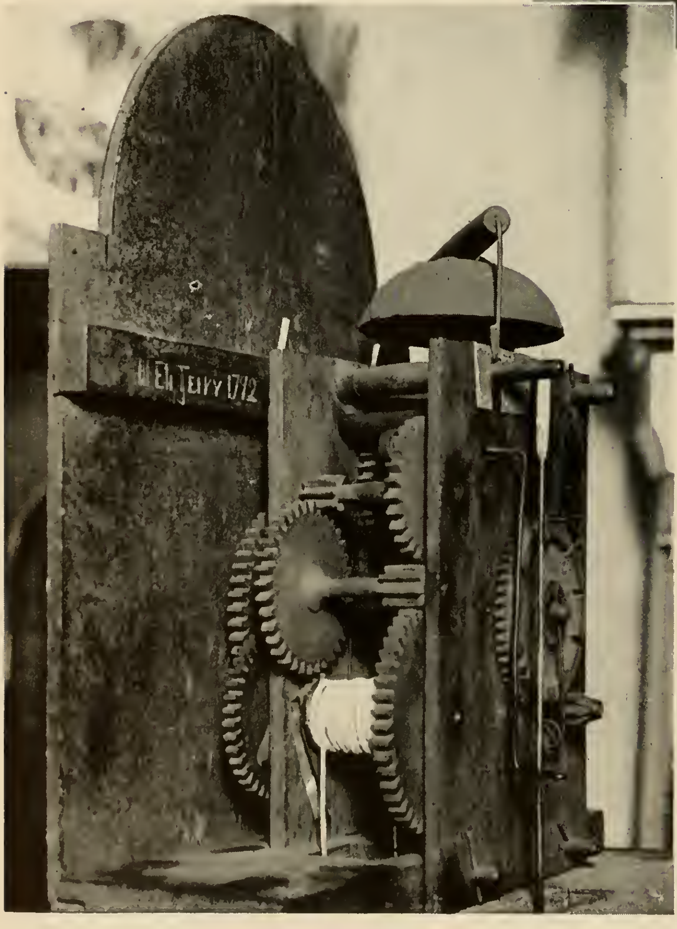


A common form of clepsydra or water clock (about 140 B. C.). The water from the conical vessel flows into the compartment below it at a known and even rate. The time elapsing during any given part of this process can be read by means of the scale at the side, or by the hand on the geared wheel

The essential element in any sundial is the gnomon. This casts a shadow which, moving with the sun, points out the hour in the dial face



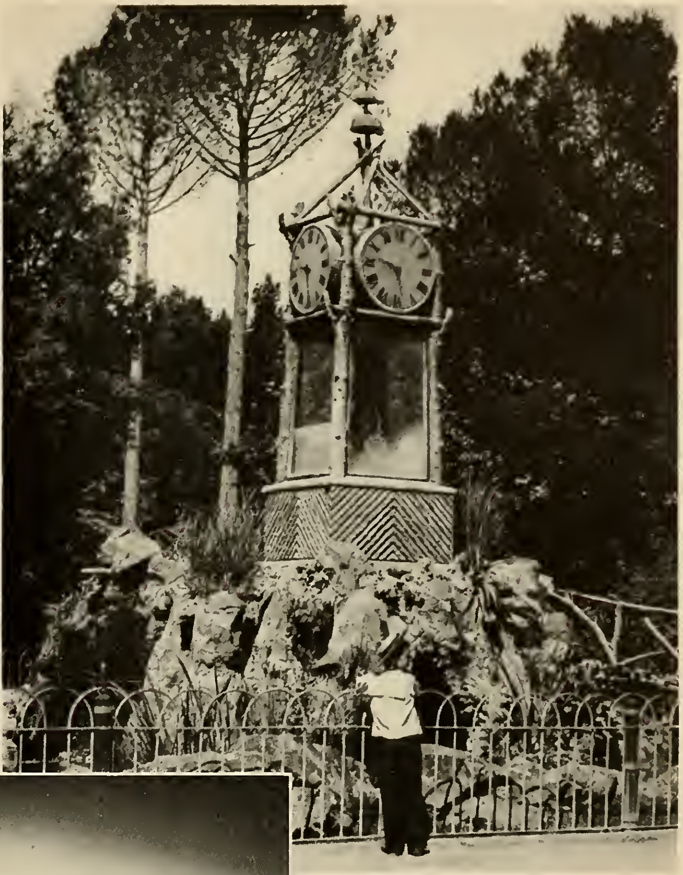
A reminder of time gone by: an interesting hourglass. The flowing of the sand from one chamber to the other marks a given interval of time. Designed for use in the pulpit, this glass doubtless brought to an end many an old-fashioned sermon



The Terry Clock, a famous old timepiece which dates back to the year 1792 and is now in the Arthur collection at the Museum of New York University. The photograph shows the clock-works from the back

Ewing Galloway

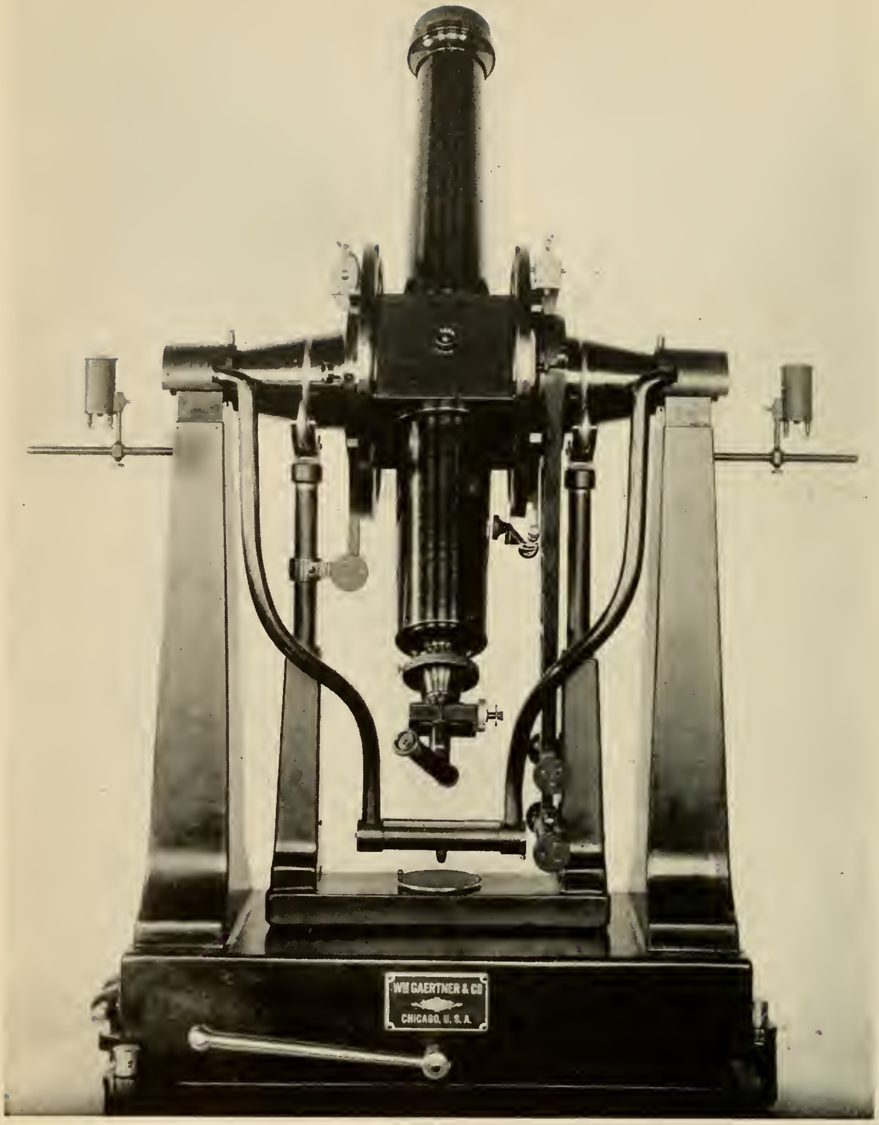
A water clock in the Pincian Gardens, outside Rome. This is a more elaborate development of the older form of clepsydra, which not only marks intervals of time but indicates the exact time



Ewing Galloway

A modern sundial. Beautiful and accurate as many dials are, all have the serious limitation of being useless when the sun is not shining. As the familiar dial motto puts it, "I mark only the sunny hours"

Ewing Galloway



Ewing Galloway

An astronomical transit. A modern instrument for the determination of accurate time

The oldest watch in existence, dating back to 1520-25. It is of the type known as the "Nuremberg egg," made by the inventor of the watch, Peter Hendlein

Cosmic Rays

A discussion of the various theories concerning the origin and behavior of the cosmic rays

By W. F. G. Swann
Director, Bartol Research Foundation of the Franklin Institute, Swarthmore, Pa.

In each second of our lives, each one of us is riddled by about ten bullets shot through us from some unknown cosmic machine guns. These bullets, the cosmic rays, have enormous energy in comparison with normal bullets of their kind. For the last twenty-five years we have wondered what they are, and where they come from.

When the physicist encounters some new phenomenon, he frequently has to gain understanding of it through circumstantial evidence, and so it is through circumstantial evidence that we have had to learn much of what we now know about cosmic rays. Our procedure must be analogous to the following.

A physicist might observe a large, jagged breach in a wall, and hear somebody exclaim, "A rifle bullet has been fired at the wall!"

"No," the physicist would argue, "a rifle bullet could not have caused a hole such as that. It must have been caused by a large, slow-moving body such as an elephant."

Or, standing by a window-pane with a clean-cut hole in it, the physicist might hear his friend remark, "Some fellow poked his walking stick through that window."

"No," he would reply, "a walking stick would have shattered the glass completely. Such a clean-cut hole must have been made by a small thing traveling at high speed—a thing like a rifle bullet!"

Our first knowledge of what are now called cosmic rays came through the discovery of the fact that the air of our atmosphere can conduct electricity. It conducts electricity through the agency of carriers in the form of positively and negatively charged atoms or molecules of air, called ions.

When left to themselves, positive and negative ions, owing to their mutual attraction, recombine to form neutral atoms or molecules. It follows therefore, that in order to maintain a constant density of ions, they must be continually reformed.

Sources of ionization

Over the land, the most potent sources of ionization are the radiations from radioactive materials in the soil and in the atmosphere. Thus, for example, although the atmosphere of the whole earth contains only about ten ounces of radon, the radiations from this radon are sufficient to contribute quite perceptibly to the ionization observed. These radiations ionize the gas by tearing electrons from the atoms as they pass by or through them.

However, there is practically no radioactive material in or over the great oceans, yet the conductivity of the atmosphere there is comparable with the conductivity over land; and is such that, even there, ions must be produced at a rate of twenty or thirty per cubic inch per second in order to maintain the necessary ion density in opposition to recombination.

Either over land or ocean, if we take a hermetically sealed vessel containing air freed, as far as possible, from radioactive contamination, and shielded from external radioactive radiations, we find that ions are actually produced in it at the rate of about twenty or thirty ions per cubic inch per second. As a matter of fact, such a rate of production of ions represents an exceedingly rare phenomenon from the point of view of the molecules themselves. If we draw an analogy between the molecules and the population of the earth, and compare the ejection of an electron from a molecule with a murder, the production of twenty or thirty ions per cubic inch per second means that the catastrophe of ionization would appear as rare an event to the molecules in general, as would the crime of murder to mankind if only one were committed every three hundred years.

About twenty years ago the Austrian physicist Hess, and later Kolhörster, measured the ionization in a closed vessel during balloon ascents and found that it increased with altitude until, at an altitude of six miles, it attained a value of about 1300 ions per cubic inch per second. This suggested the existence of a radiation which comes from outside the atmosphere, and is gradually absorbed as it penetrates into it. They concluded that the radiation possessed ten times the penetrating power of any other known radiation, and they called it the "penetrating radiation."

Cosmic radiation

Later, their results were confirmed in general outline and extended by others, through measurements on mountains, in airplanes, in manned balloons, and in apparatus carried aloft in small pilot balloons. As a result of all these experiments, we have been led to belief in the existence of a cosmic radiation, possibly composite in character and coming from above, of such penetrating power that appreciable amounts of it can pass through seventy-five feet of lead.

What can be the nature of such a radiation?

When the physicist encounters some new phenomenon such as the cosmic radiation, he likes to see it as a representative of the activities of something with which he is already familiar. He likes to think that the cosmic ray is an electron of high energy; but since the highest energy electrons obtained in ordinary laboratory phenomena can pass through no more than a tenth of an inch or less of lead, and the cosmic radiation can pass through seventy-five feet of lead, he must extend his mental picture by supposing that the electrons have exceptionally high energies. Or he likes to think of the cosmic ray as an X-ray; but, since X-rays produced in the laboratory cannot penetrate more than a fraction of an inch of lead, he must suppose that the cosmic rays—if X-rays—must be of a peculiar type to provide for this high penetrating power. His knowledge of the way in which penetrating powers of X-rays depend upon the nature of the X-rays then suggests to him that X-ray cosmic rays must be X-rays of exceptionally short wave length. In other words, the physicist does not like to invent ghosts or evil spirits to explain new phenomena. He prefers to see the phenomena as the activities of some of his old friends in new garb.

Candidates

Now among the candidates which present themselves for the position of cosmic rays are—first, electrically charged particles. Then we have X-rays of a particularly hard, or penetrating type. Ordinary X-rays are a kind of invisible light of wave length 1000 times smaller than that of ordinary light. Gamma rays, which are emitted by radioactive substances, are X-rays of still shorter wave length, and the cosmic rays would have to have still shorter wave lengths. The concept of light rays, X-rays, and gamma rays as waves is not without its difficulties. From some points of view, these radiations behave like spreading waves, while from others they behave more like streams of bullets. One characteristic feature is that their energy goes out in perfectly definite units, or quanta, as they are called, the energy in any quantum being greater the smaller the wave length. Quanta of energy of this type are frequently called "photons."

Then, within the last few years we have come to recognize the existence of another entity known as a neutron, and regarded as a composite of a particle of negative electricity and one of positive electricity traveling along in close proximity as a single entity, with a velocity comparable with that of light.

Agencies of all these types stand as candidates for the position of cosmic rays.

Then, finally, we have the dramatic suggestion of the Abbé Lemaitre, to the effect that the cosmic rays are a mixture of electrons, charged atoms, neutral atoms, and every kind of atomic or sub-atomic entity, these entities representing the débris of a gigantic explosion in which all of the matter of the sun and the stars, of the nebulæ of space and everything else, once gathered together in a single compact mass, blew up.

Now a characteristic feature of high energy charged particles is that, as they pass through the atmosphere, they ionize the air continually. They fritter away their energy in small amounts, in amounts insignificant compared with the total energy which they possess. They go on losing energy in this way until finally they have lost all and their journey comes to an end. All rays of the same energy travel the same distance. Shooting electrons into the atmosphere is like shooting bullets into a thick layer of cheese. The bullets will lose more and more energy as they burrow into the cheese, but all bullets of the same energy will travel the same distance in the cheese.

On the other hand, photons, and uncharged particles do not ionize the air continually as they pass through it. They act through assistants. A photon travels along through the medium with its energy undiminished until it strikes some atom with a particularly direct blow. Under such conditions it loses the whole of its energy, or a large portion thereof. It hurls electrons out of the atom which it has struck, and the plebeian work of ionizing the air is left to these electrons. Shooting photons into a gas is thus like shooting a machine gun into a grove of trees. A bullet will go on with undiminished energy until it hits a tree, in which case it loses all of its energy at once. If a beam of bullets be aimed more or less in one direction, all will not travel the same distance. Some will go farther than others, the number to be found at any distance from the machine gun depending upon the laws of chance as applied to the chance of hitting a tree.

Variation of ray intensity with altitude

It is easy for the reader to see, in view of the foregoing considerations, that if we should have a telescope which was capable of measuring the number of cosmic rays passing through it per minute and should point it vertically to the sky and then measure the number of rays which it records per minute for various altitudes above the surface of the earth, the way in which the number would increase with altitude would be characteristically different for charged particles from what it would be for photons. One has only to think of the bullets shot in the cheese and of the bullets shot into the forest to realize this fact. Now, experiments on the variation of cosmic ray intensity with altitude gave a result which at first sight is much more in harmony with the photon idea than with the charged particle idea.

Another matter which plays a prominent rôle in deciding between charged particles and neutral particles or photons arises from the fact that the earth is a great magnet and so possesses the power to deflect the paths of charged particles which approach it.

More than twenty years ago, Birkeland and Störmer sought to explain the aurora borealis as light emitted from the upper atmosphere by atoms which have been bombarded by electrons from the sun. Electrons of relatively low energy would be caused to spiral around the earth's lines of magnetic force so that they would strike the earth's atmosphere near the poles. Only electrons of exceptionally high energy could strike in low latitudes. In order to account for the extension of the aurora to latitudes as low as that at which it is observed, it was necessary to postulate the existence of electrons with energies 300 times as great as any with which we were actually acquainted in the laboratory. An energy ten times greater than this would be necessary to enable an electron to strike the earth's atmosphere at the equator.

Such considerations as these would lead us to believe that if the cosmic rays are charged particles, there should be a considerable variation of cosmic ray intensity with latitude. Until comparatively recently, no such variation had been found. Within the last few years, however, J. Clay in Europe, and A. H. Compton and his associates have established a definite variation of intensity with latitude; and, with this phenomenon are also associated others concerned with the variation of intensity from different points of the compass, which phenomena would be expected if the cosmic rays were charged particles.

These latitude and directional effects call as insistently for the assumption of charged particles as their absence (as formerly supposed) called for photons or neutral particles. The latitude and directional effects necessitate that we assume that at least 31 per cent of the total primary cosmic radiation must be of the charged particle kind. This 31 per cent is enough to spoil the story of variation of intensity with altitude which was so nicely provided for by the photon hypothesis. It makes it imperative that we revise our views as to the details of the charged particle hypothesis with the aim toward making it, itself, harmonize with the altitude-intensity measurements. If we succeed in this, there is no greater barrier to the assumption that all of the primary cosmic radiation is of the charged particle type.

The rays as charged particles

The modification of the charged corpuscle hypothesis which serves the end in view, is one in which we postulate that the primary cosmic rays coming from space travel for the most part right through our atmosphere, losing energy on the way. We suppose that on their journey they eject high energy charged particles, called secondary rays, from the atoms in their path. We suppose further that the number of secondaries ejected per unit of path of the primary increases with the energy of the primary, and is in fact proportional to it. These secondary rays are supposed to be the things measured in our experiments. The number of them to be found at high altitudes is greater than the number at low altitudes because the energy of the primary rays is greater at high altitudes; and on submitting the whole matter to calculation we find that the theory fits, satisfactorily, the experimental results concerned with the variation of cosmic ray intensity with altitude.

It thus appears that while the experiments do not exclude the possibility of photons as representative of a part of the primary cosmic ray intensity, they are in harmony with the view that all of the radiation consists of charged particles.

When cosmic rays pass through dense materials such as lead, they cause, occasionally, a kind of atomic explosion in which as many as five thousand high energy charged particles may be ejected. Those who favor the photon hypothesis see in this phenomenon an illustration of the actual creation of matter from radiation. For some years physics has recognized a close connection between mass and energy in the sense that if by any procedure, matter is caused to disappear, energy in the radiant form appears in proportional amount. It is calculated that the annihilation of a single drop of water would produce enough energy in the form of radiation to supply two hundred horse power for a year.

It is believed that the reverse phenomenon can occur. It is supposed, in fact, that when a photon comes into close proximity with the nucleus of an atom, it may become mathematically irritated in such a way as to cause it to change its state of existence and materialize as a shower of material particles. As a crude analogy, we may liken the phenomenon to a spiritualistic seance, in which the photon is the ghost, the charged particles the materialized ghost, and the atom is the medium.

Fascinating as this hypothesis may be, it requires modification, in detail at any rate, when applied to the explanation of the explosive emission of particles to which I have referred. For, it appears that, in these explosions, the ejected particles do not all come from one point. The phenomenon is such as to suggest that one initial center of explosion starts others in the substance, and that these, possibly, start others, so that the conglomerent explosion observed represents the débris of a large number of smaller explosions taking place throughout the substance.

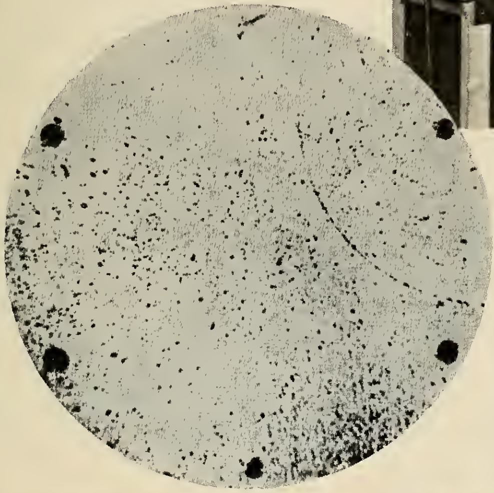
However this may be, we have here a phenomenon initiated by cosmic rays and representing an actual creation of matter; or, if not that, then a transmutation of matter from one form to another—from the form represented by the nuclei of the atoms to the form represented by the free particles which are observed when the phenomenon occurs.

Source of the rays

The origin of the cosmic rays presents an interesting field for speculation. On the view that they are photons, Millikan has suggested that they represent a radiation emitted at the instant of birth of atoms from charged particles in interstellar space. If they are charged particles, we can see how they could acquire their enormous energies under the influence of such electrical forces as might arise in something like thunderstorms on the stars. Again, we know that fluctuating magnetic fields can cause motion of electricity. It is by such means that an ordinary electrical transformer operates. Now we know that varying magnetic fields are to be found upon the sun—in the sunspots in fact; and while it is not likely that the sun could provide the energies observed in cosmic rays—although it could provide energies comparable with them—it is quite within the range of possibility that the different conditions found in other stars may provide the energies required.

Times Wide World Photo

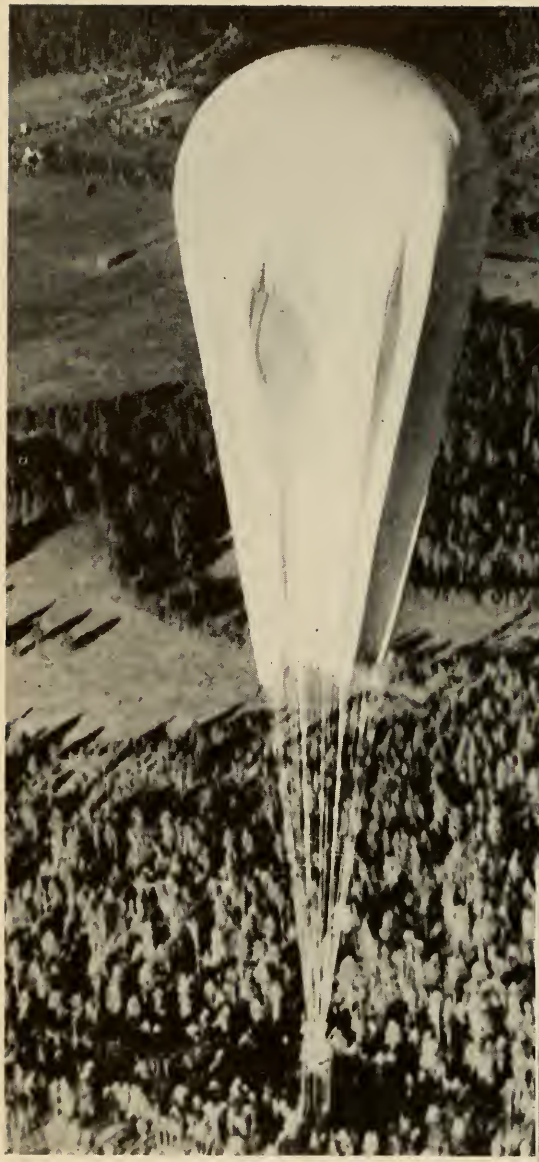
(Right) Cosmic rays penetrate a New York City bank vault. Here Doctor Swann is demonstrating his cosmic ray counter to well-known scientists. From left to right they are O. H. Caldwell, Dr. Clyde Fisher, Doctor Swann, Dr. H. F. Stetson, and Dr. Sergius Grace



(Left) This picture shows the path of a cosmic ray particle bent in its course into the arc of a circle by a large magnet. The particle has disrupted the atoms of air in its path. Upon these disrupted atoms water vapor has been condensed by a well known device and thus the path of the particle is rendered visible. (Anderson)

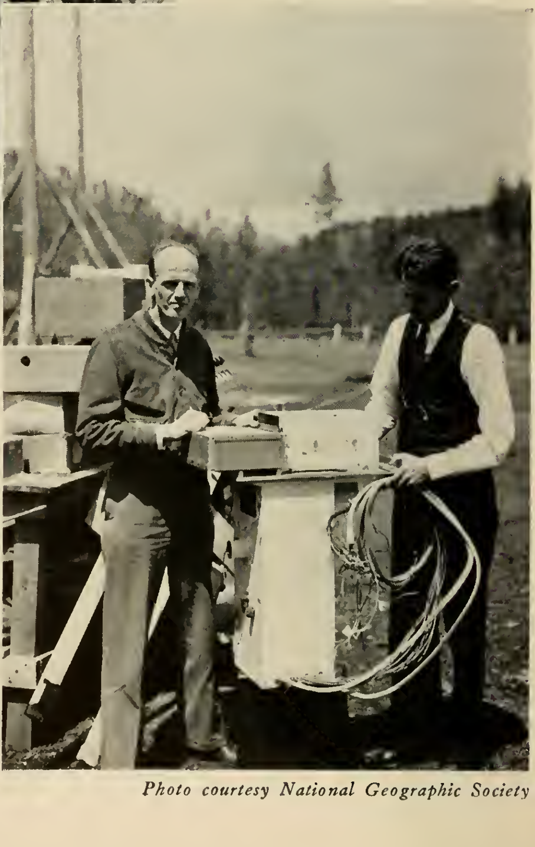
(Below) Mr. A. Zuhn, a member of the Byrd Antarctic Expedition, studying the cosmic ray at Antarctica

Photo courtesy Byrd Antarctic Expedition



Wide World Photo

(Left) The take-off of a recent stratosphere flight at Rapid City, South Dakota. The balloon reached an altitude of 60,000 feet, then crashed to earth near Loomis, Nebraska. All of the delicate instruments were smashed, but fortunately the crew was uninjured. Another stratosphere flight is being planned for the near future



Apparatus for studying cosmic rays. The picture shows Dr. G. L. Locher on the left and Mr. Oscar Steiner (holding cables), chief mechanician, of the Bartol Research Foundation, on the right. The apparatus they are holding comprises three parts. The lower, and largest unit, is a system of dial recorders designed by Doctor Swann and Mr. Steiner, for recording the cosmic ray pulses. The box on which Doctor Locher's hand rests is another recording system working on an optical principle, and designed by Doctor Swann and Mr. Steiner. The remaining piece is the camera which photographs the dials every half minute

Photo courtesy National Geographic Society

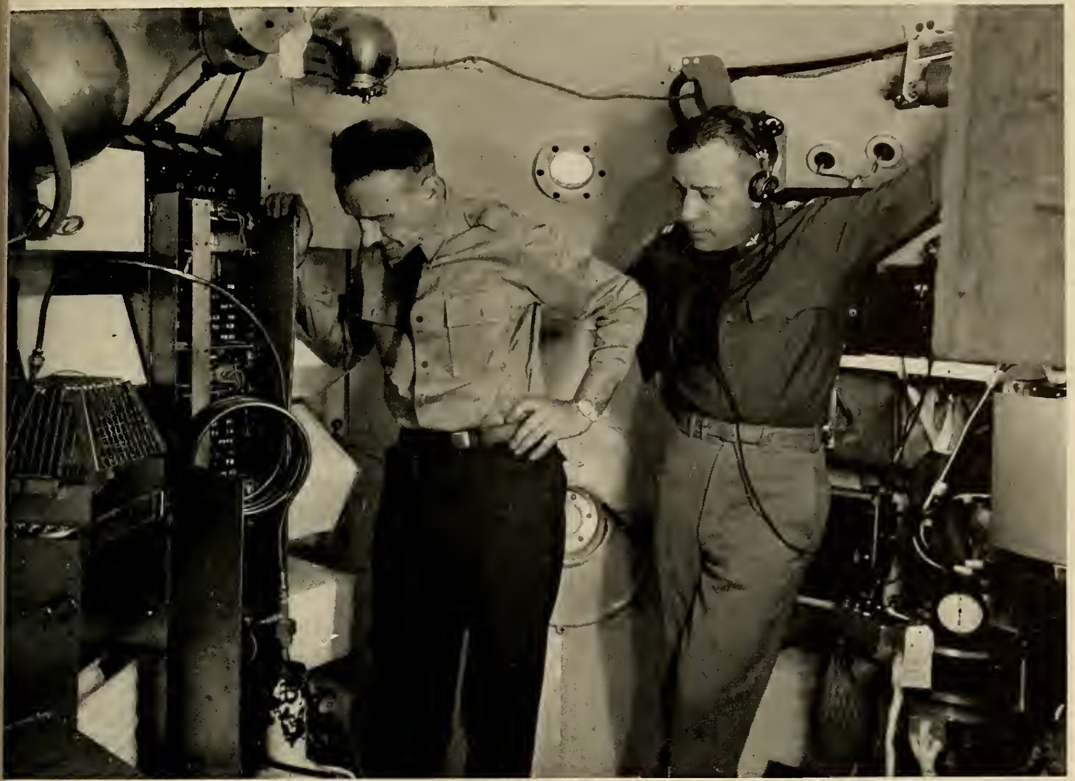


Photo courtesy National Geographic Society

(Above) Captain Stevens (left) has his hand on the Geiger counter apparatus. Captain Anderson is using the ear phones. Low down to the right, showing a dial, is a closed chamber apparatus designed by G. L. Locher for obtaining closed chamber tracks of atomic matter, electrons, and other subatomic entities burst out of atoms by cosmic rays in the stratosphere

(Right) Lyman Briggs, director of the Bureau of Standards and chairman of the Advisory Committee, and Doctor Swann. The latter is holding a new form of electroscope designed by him for use in an apparatus for measuring atomic bursts produced by cosmic rays in the stratosphere

Photo courtesy National Geographic Society

The Mysterious Moon

Separated from the earth by 240,000 miles, the moon yields its secrets to the astronomer

By Dorothy A. Bennett

Assistant Curator of Astronomy and the Hayden Planetarium, American Museum

Nearest and most studied neighbor of the earth, the moon is still an object of mystery. Despite the fact that thousands of features on its surface have been measured and mapped, there are countless formations that cannot even be explained. Although much of its surface is better known than equal areas on the earth, there is one whole side of it that has never been seen by human eyes. Even though it doubtless sprang from the same parent as did the earth, it has been denied the possibility of life.

This companion of the earth's travels in space not only accompanies the earth in its journey about the sun, but swings around the earth and turns on its own axis as well. In the course of a month it completes a circuit of its orbit and a spin upon its axis. This is the cause of a strange phenomenon—one side of the moon always faces the earth, and the other is forever hidden from earthly view. Slight noddings on its axis bring the margins into view, but even then, all that we know of the moon's now familiar face has been learned from only a little over half of this mysterious world. What lies beyond our sight can be speculated upon, but its true nature can be solved only when flights into outer space are possible.

The known half of the moon itself is hidden monthly from view when it passes between the sun and the earth. Because it is a dark, cold body, the moon must borrow its light from the sun and so moonlight is essentially second-hand sunlight. Our moon, a better mirror than some, reflects less than a tenth of the light received from the sun. Of necessity, its illuminated surface must always be that toward the sun, and in its journey about the earth varying amounts of the lighted half are presented to the earth. This, of course, is the explanation of the familiar phases, one of man's first astronomical observations and one of the most common sky happenings in his experience. Everyone has observed the moon change from crescent to full and then back again to crescent; almost everyone at some time or other has seen the "old moon in the new moon's arms." This strange effect of the bright crescent with the rest of the moon but dimly illuminated within its horns is produced by third-hand sunshine. Light from the sun has traveled to the earth, been reflected to the moon's dark side, and returned to our eyes as "earthshine."

Markings on the moon

An even better known moon marking is the "man" or "lady in the moon." Strangely enough, it is vast, smooth, bare areas on the moon's surface that produce this illusion. Once called seas, they were thought by early observers to be either great expanses of water or the dried-up beds of former oceans. But when observed with modern instruments, their dark surfaces, quite the opposite from glaring sunlit water, proved to be nothing but plains. Unlike earthly plains, these are not grassy fields but naked areas of bare rocks.

Even a small telescope reveals a great variety of markings. Extensive mountain ranges border the plains or maria. Some of their peaks tower thousands of feet above the lunar surface and far exceed the height of the tallest mountains on the earth. As the sunlight advances across the lunar surface, it caps the mountain peaks with brilliant light long before the surrounding regions or valleys below are visible. The peaks look like stars hung against the black background of the lunar surface. Then as the satellite slowly turns on its axis, the sun's rays creep forward, the valleys below come into view, and the jet shadows of the peaks drop beyond in sharp relief. From these shadows the heights of lunar markings may be determined, and from the boldness of a feature's outline its proportions may be calculated by an observer 240,000 miles away.

Lunar craters

Spotting the plains that are rimmed by mountains are many walled depressions. Ranging in size from a few miles to more than a hundred, these walled plains or craters are one of the most conspicuous and fascinating features of the moon. They are visible only in a telescope and are not large enough to appear even as a freckle upon the face of the "man in the moon." One of the most unusual of these is Newton, the deepest of the lunar craters. Located close to the south pole, it never receives the slanting rays of the sun at its base, which is far below the level of the surrounding regions. In contrast to the dark depths of Newton is the glowing floor of Aristarchus, the most brilliant of the craters. Some strange characteristic of its walls makes this crater seem to shine by its own light and it has more than once been mistaken for an active volcano. The most striking of all the surface features of the moon is the ray system about Tycho. From this ringed pit light-colored markings about fifteen miles in width extend over the moon's surface for hundreds of miles. Passing through craters and over mountains, like fingers of lava radiating from a dead volcano, they suggest faults, ridges, or cracks.

A discussion of the origin of the craters can turn the most dignified of astronomical seminars into the hottest of debating camps—one school insisting that millions of years ago when the moon was young, furious volcanic activities upheaved these ringed scars; the other, that passing groups of meteors pitted the surface in merciless bombardment. There is much to be said for either explanation, and perhaps a true solution of this mystery of the moon can be reached only by a visiting geologist pecking on the lunar rocks.

A fortunate circumstance in the study of the moon is that time is of little consequence upon its surface. Even though many centuries be consumed in the perfection of a space vehicle to take us to our near neighbor, little change would take place in the meantime, for the airless moon will not be cracked by frost or scarred by erosion in the intervening years. The same jagged outlines which were first viewed by Galileo in 1610 are even now observed nightly by moon enthusiasts.

An airless satellite

If the moon were clothed with an atmosphere, the many features visible at the edges would be wrapped in mist and the bold outlines of its mountains, plains, and craters would be clouded from view. The horns of the crescent would be exaggerated in brilliance and the jet black of the shadows would be dissipated by refraction. None of these effects is seen—no erosion smooths the jagged features, no detail is masked by clouds, no twilight borders the brilliant sunlit portions from those dark in the depths of night, no blanket of clouds thins the solar rays, and no armor of air protects the scarred surface.

A swarm of meteors rushing at the moon meets no resistance like that offered by the atmosphere of the earth. Their swift descent is unheralded by the brilliant flash and the occasional loud report which marks their advent on the earth. They strike and leave their mark, while on the earth many are lost in the upper air, and only scattered dust is evidence of their visit. With no medium in which to move, the vibrations of their fall create no sound, and an object weighing tons which penetrates the moon to a depth of many feet is as noiseless as cotton dropping upon grass.

A world without life

Without atmosphere, without water, this barren world must also lack life. The sun shining for fourteen days on end heats the lunar surface to the unbearable temperature of 200 degrees above zero, and this same surface when turned away from the sunlight without insulating air to retain the acquired heat, drops to 200 below zero. On the earth a variation of 50 degrees in temperature within twenty-four hours is considered drastic; in a lunar day, however, the change is eight times as great.

How came this airless world? Its motions, its composition, its origin and its destiny parallel the earth's. Why should it be deprived of the essential elements which make the world possible as the home of man? Did it ever have an atmosphere? If so, why has it lost it? To these questions there are two answers, both of which hinge upon the moon's lesser gravitational attraction. The moon is so small, with a diameter of only 2000 miles, that it attracts an object at its surface with only one-sixth the pull exerted by the earth. Thus, a hundred-pound earthly visitor to the moon would tip the scales at only sixteen pounds; a javelin thrower could toss his spear six times as far with the same effort. Therefore it is not difficult to see that the little moon with its feeble pull may never have been able to attract an atmosphere or hold its dancing gases. Which of these is the true chapter in the moon's history is still open to dispute, but there is little room for discussion on the actual presence of atmosphere on our satellite.

However, there are some well-known and respected astronomers who cling to the hope that there may be vestiges of life upon the distant moon. Dr. William Pickering, after a decade of study of certain craters, feels sure that changes he observes there are more than the effects of the passage of the lunar day. He is ready to assert that they are manifestations of some type of plant life which alternately springs up with the lunar day and dies out with the approach of the lunar night.

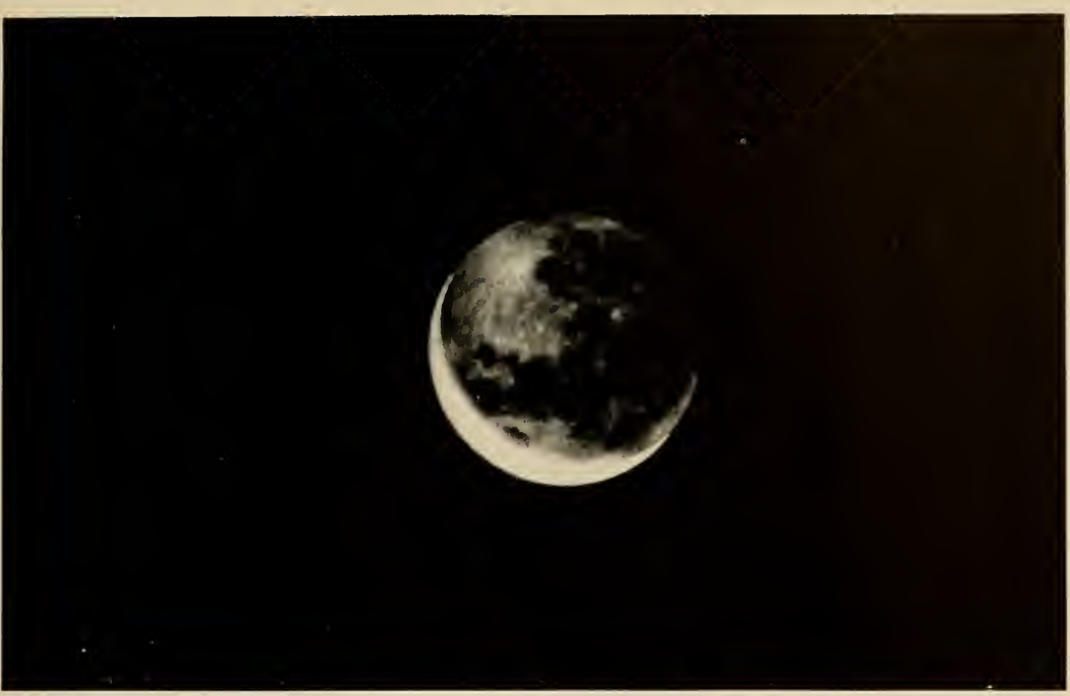
In support of their proposition, the champions of lunar life call attention to several unusual things upon the earth. There is the fact that locked within the rocks of the earth are gases. Why couldn't this be true of the moon, the composition of which is very similar to the earth's? Then, too, there is life which exists upon the earth under circumstances long believed to preclude life. In the Valley of Ten Thousand Smokes there live blue-green algæ, which are forms of life so low that they are at once claimed and rejected by both the plant and the animal world. They thrive on emanations of gases at the brink of fumaroles where the temperature is as high as 200 degrees. If these lowly creatures can keep their tenuous hold on life under such unfavorable conditions here on earth, could not some relative of theirs survive at the depths of the lunar craters? There, near to the heart of the moon, which is perhaps still hot, active volcanic vents might squeeze gases from the rocks and provide a home for lunar life.

But while one conjures with the idea of life upon the moon, that distant body vitally affects the life of thousands of people upon the earth. All the countless persons engaged in maritime activities—from the Polynesian sailor of a fragile bark to the Nordic master of a great ocean liner—are subject to the moon, master of the tides. As the sailor waits to "come in on the tide," he waits for the moon to pile the waters high at his point on the earth. Directly on the other side of the world is high tide, too, and halfway around on either side is low tide, where many a small craft is caught aground. He who sails the seas for commerce or for pleasure must know the rhythm of the tides, and his journey is patterned by the motions of the moon.

Except for those who live by commerce and its many branches, the moon has small influence upon the inhabitants of the earth. Of course, the moon has figured in the folkways of people the world over, but the actual facts about our satellite are far more intriguing than the superstitions which surround it. The so-called "ring around the moon" is far less thrilling to see than the instantaneous disappearance of a star behind the passing moon. The myth of the crescent's "holding water" is much less provocative than the thought that on no part of the moon can there be even a pool of rain water. To look over one's left shoulder and wish is far less exciting than to look into the telescope and see the endless variety of lunar markings upon which no man has ever set foot.

Close at hand, the moon is of greater importance to the earth than any other body except the sun. But even in the solar system the moon is a midget; it becomes a mere molecule when considered in relation to the star system as a whole and counts for less than nothing in the vast expanse of the known universe.

However, it is far better to be a "big frog in a little puddle"—and the moon is major domo at many phenomena near home.

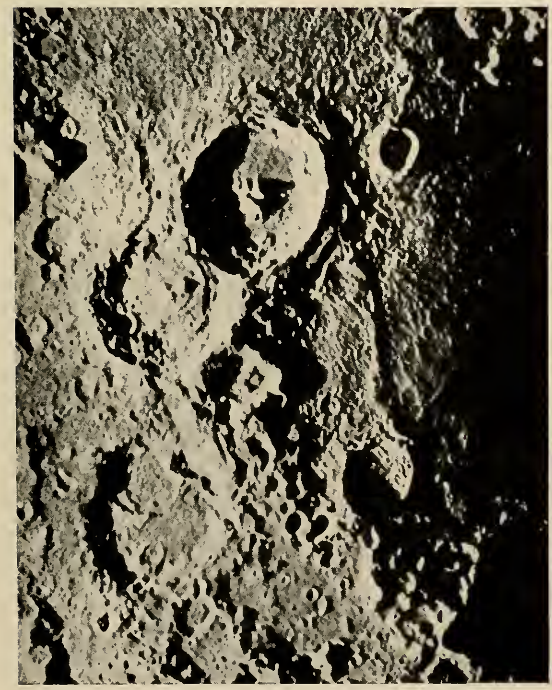


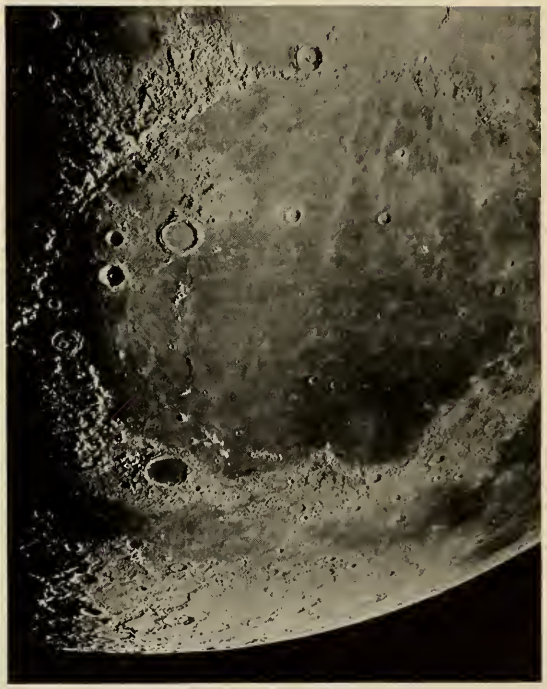
Yerkes Observatory

(Above) The old moon in the new moon's arms. The dark part of the moon, barely visible in earthshine, is rimmed by the slender sunlit crescent

(Below) The Crater Theophilus in the light of the setting sun

Mt. Wilson Observatory





Mt. Wilson Observatory

(Above) Mare Imbrium. The smooth expanse of this lunar plain is bordered by mountain ranges, pitted by craters, and streaked by rays from the great walled plain, Copernicus. The towering peaks that ring the area outline the 750-mile-wide "Sea of Rains"

Science in the Field and in the Laboratory

Astronomy, American Museum Expeditions, Nature Trails, Education, Research, Accessions

Edited by A. KATHERINE BERGER

Opening of the Hayden Planetarium

On Thursday, October 3, the Hayden Planetarium of the American Museum of Natural History will be opened to the general public. On every day of the week except Sunday, the public lectures will be held at the following times: 11 A. M., 2, 3, 4, 8, and 9 P. M. On Sundays there will be lectures at 2, 3, 4, 8, and 9 P. M. The price of admission to morning and afternoon performances will be 25 cents, and to evening performances, 35 cents. Reserved seats in the afternoons will be 50 cents, and evenings 60 cents. While the lecture to be given during the first few weeks will be of a general and elementary nature, it is planned that later on other types of lectures may be given, as well as some on specialized subjects. The staff of the Planetarium consists of: Dr. Clyde Fisher, curator; Mr. William H. Barton, Jr., associate curator; Miss Dorothy Bennett, assistant curator; Miss Marian Lockwood, assistant curator; Mr. Arthur Draper, assistant curator.

Amateur Astronomers Association

Because of a conflict with the opening date of the Hayden Planetarium, the first meeting of the Amateur Astronomers Association for the season 1935-36 has been postponed to Wednesday, October 9. At this meeting Dr. Clyde Fisher, president of the society, will speak on the subject, "The Hayden Planetarium." The second meeting of the society will be held on Wednesday, October 16, when there will be a forum meeting open to general discussion by the members. Both of these meetings will be open to the public, and anyone who is interested is most cordially invited to attend. At the meeting of October 9, announcement will be made of plans for the classes and special activities of the society for the season.

Henry Dill Benner

Members of the Amateur Astronomers Association and their friends will learn with regret of the passing of Mr. Henry Dill Benner. Mr. Benner had been for many years a staunch friend and advisor of the Association, and had brought to many people an interest in the stars. He devoted a great deal of his time to popularizing astronomy in the last thirty years, both by personal interview and by letters to the newspapers. Mr. Benner was never too busy or too tired to talk with those who were interested in the stars. Amateur astronomers the world over have lost a good friend!

The Vernay-Hopwood Chindwin Expedition

The Vernay-Hopwood Chindwin Expedition, organized and led by Mr. Arthur Vernay, completed three months in the field and returned to Rangoon on April 5, 1935, from which point shipment was made of the numerous specimens collected in Burma. All the collections have now been received at the American Museum of Natural History and distributed to the various departments.

The work of identifying and studying some of the collections is already under way. Preliminary study by Doctor Mayr of the collection of birds shows that among the nearly 800 specimens of this group there are represented more than 200 species.

Study of the collection of mammals will await the preparation of the skulls and the tanning of skins, some of which have already been prepared.

The collection of reptiles and amphibians consists of 430 specimens and contains several species new to the Museum's collections; the most striking among the latter are a large banded krait and other snakes and two or more species of river turtles.

The collection of fishes, comprising nearly 600 specimens, contains, according to Mr. Nichols, considerable material new to the Museum's collections though related to species obtained by the

Asiatic Expeditions of the American Museum in China.

The anthropological collection consists of a variety of objects, such as baskets, pottery, bows, bark cloth, hats, etc., from the Kachin and Chin tribes of Northern Burma, and some will be put on exhibition. The face molds, some of which have already been cast, show the features of the peoples of Northern Burma, namely, Kachins, Chins, Nagas, Shans, and Burmese.

The motion pictures give a very good idea of the character of the country and some of the activities of the people. These include several views of women weaving on hand looms and spinning, the method used by Chins and Kachins in pounding rice, etc. Some of the pictures taken in a head-hunters' village show these people at various tasks, ending with the kind of dance which concludes a head-hunt.

There are a few scenes showing gibbons, the smallest and by far the most active of the apes, swinging through the treetops by their long slender arms.—H.C.R.

Auto travel on deserts

Those who have followed the Mongolian explorations of the American Museum's Central Asiatic Expeditions under the leadership of Dr. Roy Chapman Andrews, now the Museum's Director, will be interested to know that he will talk about his experiences with Mongolian bandits on the Socony-Vacuum program at 8 o'clock Friday evening, October 4, over the Columbia Broadcasting System. At the same time Doctor Andrews, who was the first explorer to penetrate the Gobi by auto, will speak about the problems of auto travel in the desert. An idea of the extent of his travels may be had by the fact that Doctor Andrews' expedition consumed about 30,000 gallons of gas.

"We transported the gasoline by camel, for there are no filling stations in the Gobi," said Doctor Andrews. "Many camels died and we suffered severe losses of gas through leakage. The change of 70° between night and day temperatures caused many tins to burst at night. They went off like firecrackers but, luckily, did not catch fire. The leakage on the 1922 expedition was almost 50 per cent, but by 1925 we had reduced this loss to 25 per cent."

The Bear Mountain Nature Trails

The Bear Mountain Trails, Trailside Museums, and zoos, operated jointly by the American Museum of Natural History and the Commissioners of the Palisades Interstate Park, have been maintained since July first by the state of New York. The following separate Trailside units have been open to the public during the season: the original Trailside Museum, the Trailside Botanical Museum, the Historical Museum and the Geological and Crafts Museum. The main Nature Trail has been completely re-labeled and has been open continuously since January first.

During the winter the trails and the Historical and Geological Museums will be opened daily from 9 A. M. to 5 P. M. The Trailside Botanical Museum will house the zoölogical collections during the cold months, and the Crafts Museum will be used for the storage of materials.

There have been many new developments during the summer. All trail signs are new and, in addition, the Acorn Trail has been doubled in length. It is to be used by high school groups during the fall as a biology test trail, and will include 150 test labels to be answered in connection with a mimeograph sheet. During the winter a new "snow trail" will be built. Particular attention will be given to winter buds, snow forms, animal and bird tracks, identification of trees by bark, etc.

A nature school was held on the Trailside area under the auspices of the Trailside Museum from July 1 to August 15. Group work was conducted for five days each week, with an eight-hour period daily. The students ranged in age from fourteen to twenty. The subjects given included the fields of zoölogy, botany, and general biology. Field trips were made and the students learned to trap small mammals, and to prepare study skins. Dissections were made of mammals, fish, reptiles, and insects. Attention was also given to the care and feeding of animals.

At the conclusion of the course the students were permitted to build a museum of their own in the Craft House. The students also operated the Trailside Museum for a period of four days. The teaching program resulted in several splendid collections for the Botanical Museum and also assisted Trailside employees materially in their daily work. Practical experience was the keynote of the course.

Activity in the Botanical Museum included the daily preparation for exhibition of at least fifty species of flowering plants. An exhibit of systematic botany proved popular with visitors. Living plants and colored diagrams told the story of plant development, "from algæ to flowers."

The Trailside Historical Museum was unofficially opened on August 15. The generosity of many local donors made possible the exhibit of fine historical material ranging from colonial household articles to revolutionary rifles. The building is completely equipped with exhibition cases and the interior construction is finished. The Hyde Memorial Library is in working condition, with a total collection of 6000 books and pamphlets. Archæological field trips in the Hudson Highlands resulted in the collection of Indian implements now on exhibit. This material included many arrow points, pottery fragments, and similar items.

For the first time in several years the original Trailside Museum was enabled to present a "living check-list," of all amphibians and reptiles of the

Hudson Highland region. The entire interior of this museum was re-arranged to demonstrate the possibility of giving a fairly complete representation of local animal forms in a systematic manner. Wild life conservation and life history instruction were emphasized throughout the exhibit. More than 300,000 persons visited the trails and museum from January 1 to September 1.

The Trailside Museum staff for the 1935 season included William H. Carr, director; Anthony L. Roos, general assistant; Kenneth L. Lewis, zoölogist; Carl Steckert, assistant zoölogist; John H. Pierce, George W. Swenson, and Warren W. Wilson, botanists; Richard Koke, and Frederick C. Barron, historians; James B. Burggraf, archæologist; Raymond F. Torrey, librarian; Andrew T. McKee, secretary; Richard L. Manville, field zoölogist; Jessie L. Dennison, field archæologist. Miss Betty Ertel, of the American Museum Library, arranged the Hyde Library. Volunteer workers included William Dedrickson, Alwin Tabor, Valentine Clay, Nina Thomas, and Robert Ossman. In addition there were eleven workers supplied by the T. E. R. A. including two cabinet makers and six gardeners.

A new American Museum bird group

In May of this year Dr. Ernst Mayr (who was in Europe at that time) went to Switzerland to collect material for an Alpine Group for the Birds of the World Hall. The season proved to be too early for the successful negotiation of this task, but Doctor Mayr was fortunate enough to meet M. Olivier Meylan, well-known Swiss ornithologist, who gave him valuable advice toward the selection of the site of the group and the composition of the bird fauna of that region.

Mr. Francis L. Jaques, staff artist of the department of preparation, left New York on July 6 to get the material and the sketches for this group. He selected a site in the Zermatt Valley at the upper tree limit, right opposite the magnificent peak of the Matterhorn. Excellent weather during much of the stay facilitated his work, in which he was assisted by Mrs. Jaques and M. Meylan. The group will contain a panorama of the mountains of the Matterhorn and Monte Rosa chain, and in the foreground a cliff, a pine tree, and rhododendron bushes with their typical bird life.

This group, like that of the New Forest, next to which it will be placed, is the gift of Mrs. Carll Tucker.

The Whitney Wing, American Museum

The transfer of the study collection of birds (including the Rothschild collection) from the north wing to the Whitney Wing, which was begun in February last, was completed in September. While the arrangement is still far from final, all the specimens are now accessible. The first guest student, Dr. Josselyn Van Tyne, curator of birds of the Museum of the University of Michigan, occupied quarters in the Whitney Wing for a week in mid-September while studying East Indian birds in the Rothschild collection, and specimens have been loaned to other students both in this country and in Europe.

Skipjacks

The dolphin, not the cetacean mammal (porpoise) so called, but the fish, ranges the high seas seeking what smaller fishes it may devour and thus collects many interesting specimens. Through Dr. E. W. Gudger, the American Museum has received from Mr. Aycock Brown two little fishes, skipjacks (*Caranx ruber*) taken from the stomachs of dolphins of ten or fifteen pounds weight near the whistling buoy on Cape Lookout shoals, North Carolina, the beginning of June, which are of interest as they are the smallest individuals of this species we have seen. The larger is slightly more than two inches and the smaller slightly under an inch and one half long without fins, and a little the deeper-bodied of the two. Evidently these young lead much the same life and have colors similar to those they have when larger, whereas the young of their close relative the yellow-jack (*Caranx bartholomaei*) at this size are decidedly deep-bodied, with a mottled concealing color, and hide about drifting gulfweed where a hungry dolphin could hardly seize them without obtaining a mouthful of weed at the same time, and, indeed, probably seldom even sees them.—J. T. N.

Madagascar fishes

The American Museum has just received from the British Museum (Natural History) through Dr. Errol I. White the first consignment of Lower Triassic fishes collected in Northeast Madagascar during the Vernay-Archbold expedition in 1929.

The particular interest of these fossil fishes from Madagascar is that they have many elements in common with those found in beds of the same age in South Africa on one hand, and with those of Greenland on the other, so that they suggest a uniformity of climatic conditions in distant parts of the world in that far-off age.

The American Museum owes much to the care with which Doctor White has identified and classified this collection, which he made as a member of the Vernay-Archbold expedition. Several other instalments will be sent later, making in all three to four hundred specimens for this Museum.

Local insects and spiders

Two of the charms of entomology are that its study has been far from exhausted in even the most-studied regions, and that there is an abundance of material at our very doors. This latter point is exceedingly well shown at the American

The American Museum Book Shop

The Book Shop, with a view to making available to Museum members and visitors other sources of information on natural history subjects, now has on hand, besides books allied to Museum interests, miniature yet practical collections of butterflies, shells, minerals, small aquatic specimens, etc.

Special emphasis is being placed on books and material on natural science, suitable for children

Museum by an exhibit of some of the insects that were collected in a certain yard in a suburb of New York. It is an "open secret" that the yard in question contains the residence of Curator Lutz but, beyond saying that the total is "well above five hundred," he is not yet telling how many species actually have been found there.

This year, as in several previous seasons, Doctor Lutz turned a part of his residence into a "field laboratory" of the Museum's department of insect life. His work largely concerned the effect of infra-red radiation upon insects, but he also conducted some experiments on the still unsolved problem of the extent to which hearing is a part of the lives of insects. In each of these studies he had the helpful coöperation of Mr. E. N. Grisewood of New York University. Mr. Watson of the Museum staff, and Mr. C. B. Lewis, Jr., a volunteer assistant, worked on the life-histories of butterflies and moths. Also, Mr. Gertsch of the Museum staff, living in the same town, used the basement of his residence as a laboratory for observations on the life-histories of spiders.

Truly, "the study of insects has been far from exhausted in even the most-studied regions and there is an abundance of material at our very doors."

Rare human skeletons from Athens

Four human skeletons from Athens have been received recently by the American Museum through the courtesy of the Greek Government and Dr. Leslie Shear of the American School of Classical Studies. The earliest one dates from the Neolithic period, prior to 3000 B. C., the others are Mycenean (1200 B. C.), Protogeometric (1000 B. C.) and Geometric (eighth century B. C.). These very rare and scientifically valuable remains were found in the Athenian Agora during the course of excavations which are being undertaken by the American School for Classical Studies.

American Northwest Indian study

Doctor Clark Wissler visited the Blackfoot Indian Reservation in Montana and the Glacier National Park, conferring with the Naturalist Service of the Park on methods of presenting information concerning the Indian tribes originally ranging through the Park. Two field assistants, Messrs. C. E. Schaeffer and D. G. Mandelbaum were working on adjacent reservations, the former with the Kootenay and Flathead west of the Park, the latter with the Cree of Southern Canada. The coördination of these three field trips is expected to increase our knowledge and collections for the Indian tribes formerly residing in the vicinity of Glacier National Park.

A resignation

On July 1 of this year Dr. and Mrs. Robert T. Hatt resigned from the staff of the American Museum in order that Doctor Hatt might accept the directorship of the Cranbrook Institute of Science at Bloomfield Hills, Michigan.

Mrs. Hatt (Marcelle Roigneau) was first assistant in charge of exhibits in the department of human and comparative anatomy, and the Hall of the Natural History of Man owes much of its artistic groundwork and arrangement of exhibits to her talents and ability. She also collaborated with the curator in the preparation of the Guide Leaflet for this hall. At the time of her leaving she had been appointed assistant curator after serving for thirteen years as artist and staff assistant.

Doctor and Mrs. Hatt will be greatly missed by the Museum and especially the departments with which they were so long associated.

New Reptiles and Amphibians from Chindwin

The collections of reptiles and amphibians secured by the Vernay-Hopwood Chindwin Expedition comprise more than 400 specimens. Among the many interesting species in the collection is a series of very large fresh-water turtles, Kachuga. This turtle is rare in museums, because of the difficulties of collecting and transporting so large a form. A large series of giant gecko was obtained showing all stages in the development of the individual. The snakes include two species of banded krait not previously represented in the American Museum collections.

Annual exhibit of The Aquarium Society

The Aquarium Society held its annual exhibit in the American Museum early in September. This year's exhibit was characterized by the large number of reptiles and amphibians on display. One of the more interesting demonstrations was a series of minute frogs hatching directly from the egg. This species is a West Indian form which skips over the tadpole stage. The eggs are laid on land and in no stage of the life cycle do the frogs enter water. There are several species in the group. The material on exhibition was reared in the biological laboratories of the American Museum.

Botanical Garden free lectures

Saturday afternoons at 3:30 the New York Botanical Garden is giving a series of free autumn lectures in its Museum building. For October the subjects include, in the order of presentation, "Fall Work in the Garden," by T. H. Everett; "Autumn Coloration," by A. B. Stout; "Mushrooms, Edible, Poisonous, and Otherwise Interesting," by F. J. Seaver; and "Fungi and Our Food Supply," by B. O. Dodge.

RECENTLY ELECTED MEMBERS

A REPORT from the membership department lists the following persons who have been elected members of the American Museum:

Life Members

Miss Anna Murray Vail
Doctor Clarence Thomas Lansing
Mr. Edward S. Pettigrew

Sustaining Members

Mrs. Edward L. Ryerson, Sr.
Mr. William A. Johnson

Annual Members

Mesdames Frederic T. Parsons, Charles H. Sabin, Edith D. Thomson.

Misses Martha A. Jamison, Ellen D. Sharpe.

Messrs. Samuel H. Kaufman, Frank H. Lee, H. A. Obst, George O'Neill, Frank H. Parsons, Grant G. Simmons, Jr., William M. Sperry, 2d, Ralph Talamo-Rossi, John C. Weadock.

Associate Members

Mesdames Olena J. Bristol, Russel Chesebrough, Sally Lane Erskine, William Frederick Finney, J. P. Fourqurean, Ferdinand C. Lee, Frederick L. Leining, C. E. Morrison, Jr., Wolcott Ely Newberry, Peter Reiss, Robert Baird Riggs, L. W. Robinson, Jr., Ruth Ruh, Lida F. Scott, J. G. Shedd.

Misses Lillian R. Daus, Maria Luisa de Leon, Joan DeRoy, Annah P. Hazen, Lillie B. Hudepohl, Orda M. Mawhor, Lillian Parker, Sylvia Petrovsky, Leora F. Quinn, Adele Roeder, Alla Ross, Josephine Toon, Gladys E. von der Goltz, Helen Walcott, Elizabeth C. White, Hazel E. Woodward.

Doctors B. J. Brzenski, Waite A. Cotton, J. V. Gilbert, S. Crawford Gillespie, W. H. Hall, Werner Marchand, Robert B. McNutt, Donald H. Miller, Franklin Mittau, Edwin J. Nestler, A. Kendrick Osgood, G. H. Proper, Charles Radack, Leo L. Rubin, Benjamin Schwartz, C. Herbert Smith, Louis Stahl, Tracy B. Sturdevant, Frank E. Taft, Byron H. Weeth, William A. Xiques.

Honorable Harry Stewart New

Messrs. William P. Abbott, Merle Boyd Brusso, R. C. Caskey, Edward C. Congdon, Alfred A. Cordes, John Crucini, Saul Fischer, Henry Fisher, William J. C. Grant, L. P. Hancock, Richard T. Harriss, David E. Harrower, Edward A. Harrs, Robert C. Hilldale, Lloyd B. Jeffrey, F. C. Koch, Clifford La Roge, Lewis B. Lawrence, Victor Wilhelm Lindauer, T. A. Lupton, Chas. E. Maps, Garfield David Merner, Geo. A. Morava, Jr., A. Edward Morrison, James B. Neal, Alfred Roman Neff, W. F. Nelson, Raymond T. Parrot, James R. Patterson, Lynn R. Rich, Herman E. Riddell, J. Clifford Rosengarten, Juan M. Rosso, George J. Schreiber, 3d, John A. Shaw, Jr., John Lambert Sipple, Harland Soper, Jr., C. J. Sullivan, Paul Svendsen, Matthias Thorsteinson, Edward E. Tompkins, Henry C. Triggs, Walther B. Trost, Charles J. Wagner, Theodore J. Werle, Arthur M. Wickwire, H. J. Wolff.

Reviews of New Books

Relativity, Stars, Psychology, Birds, Fishes, Hobbies, Exploration

RELATIVITY, GRAVITATION AND WORLD-STRUCTURE. *By E. A. Milne, M.A., D.Sc., F.R.S., at the Clarendon Press, Oxford, 1935, 364 pages, $8.60.*

THIS book is the latest in the "International Series of Monographs on Physics" edited by R. H. Fowler and P. Kapitra. It contains the material originally delivered as lectures at the University College of Wales. The book is divided into four parts: I. Kinematics and Relativity, II. Kinematic World-Models, III. the Career of the Universe, IV. World-Pictures. In addition, there is an appendix of mathematical notes. It is obviously intended only for mathematically trained people, and the somewhat lengthy character of the monograph may deter the casual reader.

Professor Milne shows that an expanding Universe can be described in terms of the Special Theory of relativity only. All the important facts connected with *our* expanding Universe in particular can be described without the introduction of General Relativity and curved space, and this book should be recommended to students of "Special Theory." The mathematics is clear and rigorous. As a contribution to cosmology, however, the physicist may have serious objections to some of the essential deductions. Milne's description postulates an infinite Universe, something that astronomers had hoped to have escaped since the recognition of curved space. Milne does not believe in curved space and claims to prove that it does not exist. He especially attacks some of the analogies given in the semi-popular writings of Eddington as being misleading. The reviewer is of the opinion that Milne at this point is not doing justice to Eddington's artful verbal illustrations. The attempt to rule out a Universe consisting of a finite number of stars so that every star would have neighbors on all sides is not stringent and unsuccessful. The curved Universe is not more difficult to imagine than Milne's masses at infinite distances, and as to a dynamical understanding of the Universe Milne's theory gives very little hope. It is interesting to know, however, that Milne has succeeded in establishing a flawless mathematical structure as a "map," representing the kinematical features of the observed phenomena.

Some of the subjects dealt with in the last parts of the book are: cosmic rays; cosmic clouds; the career of the Universe; the world picture on the simple kinematic model; Newtonian and relativistic cosmology; comparison between simple kinematic systems; the systems of current relativistic cosmology.—J. SCHILT

THE EARTH AMONG THE STARS. *By Marian Lockwood and Arthur L. Draper. Basic Books, Inc., New York City, 1935. 35c.*

HERE is a book for beginners in Astronomy. It is a readable, non-technical introduction to the subject, written by two enthusiastic students who have not lost the layman's point of view. The best book for beginners in any field is not usually written by a specialized research student or by a profound university professor, but generally by some one who has lately traveled the trails over which he wishes to lead his readers.

The senior author has been for several years secretary of the Amateur Astronomers Association, and both are members of the editorial staff of *The Amateur Astronomer*. Both Miss Lockwood and Mr. Draper are assistant curators of astronomy and The Hayden Planetarium at the American Museum, and will lecture in the Planetarium. By answering innumerable and various questions in astronomy that have come to them in these capacities, they have had abundant opportunity to learn what the layman—both juvenile and adult—wishes to know. The value of this experience is evident in the selection and arrangement of the material.

There are eight chapters in the book, namely, "The Earth Among the Stars," "The Solar System," "The Interstellar Messenger," "The Stars," "The Milky Way," "The Spirals," "The Universe," and "Astronomy for Amateurs."

The last of these answers the question so often asked, "What worthwhile work can an amateur do?" Among the suggestions here are: observing meteors, with information concerning the American Meteor Society; locating and studying meteorites, with information concerning the Society for Research on Meteorites; observing variable stars, with information concerning the American Association of Variable Star Observers; and suggestions on making one's own telescope.

These chapters are followed by a brief, well-selected list of books and magazines. Following this is an indispensable index. The interesting and unusual drawings and the fine astronomical photographs from the Mt. Wilson and Yerkes observatories add much to the value of the book.

After a careful reading the reviewer is reminded of the hope—here realized—of the author of a well-known classic for a book "written by a pen that not only shall accuracy govern, but imagination inspire."

This little volume of scarcely one hundred pages should find wide use among amateurs, both young and old.—CLYDE FISHER

ANTHROPOLOGY IN ACTION. *By G. Gordon Brown and A. McD. Bruce Hutt. Published for the International Institute of African Languages and Cultures, by the Oxford University Press, London, 1935. 264 pp. map, 4 appendices. Price $2.75.*

ENGLAND is not only the great mother of colonies, but has evolved a profession of colonial administration the like of which is not found elsewhere. She has led in the applications of anthropology to the handling of native races. The volume under review deals with an actual experiment in which a professional anthropologist was assigned to the colonial governor's staff in Tanganyika Territory, Africa. The duties of the anthropologist were to give reports and answers to questions formulated by the administrator. Among the questions reported upon were the following: What is the smallest unit of local government in this tribe? What is the native concept of law? What aspects of the marriage customs of this tribe should be known in connection with the new rule enforcing the registration of marriages and divorces?

A fairly long list of such questions was submitted and investigated. The text of the book not only gives answers but presents many other interesting facts about the life of the people in question.

While this book may be considered technical, nevertheless, readers of this magazine should be interested in the general method of procedure because our own Department of Indian Affairs has adopted a similar policy in appointing young anthropologists to its staff to perform similar service. A number of these investigators are already stationed on the various Indian reservations, and the institution of this policy promises a more rational and effective administration of our Indian tribes.—CLARK WISSLER

ALPHABETICAL GUIDE TO BIRD EXHIBITS.

AN "Alphabetical Guide to the Bird Exhibits," recently issued by the American Museum, supplies in pocket form, at the cost of five cents, information in regard to exhibits which tells the visitor what is on display as well as exactly where it may be found.

OCEANIC BIRDS OF SOUTH AMERICA.

TOWARD the end of the year the American Museum will issue as a special publication a two-volume work by Dr. Robert Cushman Murphy, entitled *Oceanic Birds of South America.* It will be illustrated by upward of fifty maps, many other text figures, photographs, and sixteen plates in color from paintings by Mr. Francis L. Jaques.

The book is based upon field work by Doctor Murphy and other representatives of the Museum, and particularly upon the circumnavigation of the continent conducted during the years 1912 to 1917 by Mr. Rollo H. Beck, an undertaking supported by two Trustees, Mr. Frederick F. Brewster and Dr. Leonard C. Sanford. The scope of the study includes the islands in all oceans around South America, even to points as distant as Ascension, St. Helena, Juan Fernández, the Galápagos, and the American quadrant of Antarctica. In no other single book are maps and chapters on the regional geography of such localities to be found.

Part I of the publication deals with American Museum expeditions, the physiography, meteorology, and oceanography of the several environments, and the physical characteristics of the four oceanic life zones of the southern hemisphere with regard to the ranges of sea fowl. The distribution of reef corals, kelp, mangroves and seaboard vegetation, invertebrates, fishes, seals, and other organisms is discussed in correlation with that of coastal birds. There are sections devoted to guano, to ocean currents, to the nutritional basis of marine life, and to a topical description of the entire South American shore line.

Part II comprises life histories of about 170 species of marine birds, with special emphasis upon interpretation of behavior and the factors which have determined the ranges. The text for each family is preceded by a general account describing the place of the group in South America, with reference to ultimate source and the routes of dispersal in so far as these are indicated.

EXOTIC AQUARIUM FISHES. *By William T. Innes. Innes Publishing Company, Philadelphia. 460 pp. 290 illustrations, 41 color plates. Price $5.*

DR. INNES has achieved the author's dream. His book has appeared as he wrote it and in the form he planned. The mechanical production was done by the author's own firm, and he has thus been able to give full justice to his subject in details of paper, printing, and the reproduction of his pictures, even to having the pictures where they belong, instead of pages away from the fish to which they refer. As a final touch, the handsome binding is waterproof!

The technical (taxonomic) details of the book were edited by an ichthyologist, Dr. George S. Myers of the National Museum, who also helped with the distribution maps. These maps show the world distribution of the more important families, and the end papers form world maps to which a key reference indicates the points from which each species has been collected. This is a very complete book, and contains a wealth of information about collecting, transporting, selling, breeding and caring for tropical fishes. The photographs are adequate and very beautiful. It is a well-made book both externally and in content.—F. LaMonte

Fishes and Their Ways of Life. *By Louis Roule. Translated from the French by Conrad Elphinstone. W. W. Norton & Company, New York, 1935. 312 pages. 52 text-figures. Price $3.75.*

Dr. Roule, who is on the faculty of the Natural History Museum in Paris, has covered an immense range of subjects in his latest popular book. The nineteen chapters, dealing with everything from the ingredients of that famous fish stew, bouillabaisse, to sharks' teeth, poisonous fishes, and the mechanics of respiration, are brought into some sort of unity through the author's personal philosophy derived from his experience as a naturalist.

Due to his pleasant, unhurried style, everything Doctor Roule writes is good reading, and in this connection high praise should be given to Mr. Elphinstone's fine translation. There are, however, three chapters of the book that stand out particularly—those concerned with organic correlation. To quote from the chapter entitled "The Sun-Perch and the Catfish," which is in the form of a conversation between a father and son on the subject of acclimatization:

"Think, for a moment, of the body which all creatures possess. It is made up of juxtaposed organs . . . All are fashioned for the work they have to do and their particular condition is thus determined by that of its neighbours. To this state of affairs we give the name 'organic correlation'. There is equilibrium among all. If one were to increase out of proportion, or were replaced or taken away, its neighbours would feel the consequences, and a new equilibrium would have to be established. So with species living in a definite place; they are in mutual relation as it were, as the organs are to the body.

"Nature has a biological correlation as well as an anatomical correlation. The species coördinate the needs of life as between themselves. They have a toleration and a balance of their own. This equilibrium varies in its details, but is maintained as a whole . . . "

This equilibrium relates to all the external circumstances reacting on the creatures—water temperature, composition, content, etc., but the main consideration is that of food supply. In this chapter and the chapter on carp farming, called "Scales, Mirrors, Leathers," Professor Roule discusses the points to be considered in the introduction of foreign species, both in respect to the new fishes, and the upsetting of balance for the old. In the interesting chapter on "The Whitefish of Lake Geneva," he uses this lake as an illustration of a limited area with a material equilibrium of its own.

The author's enthusiasm and his kindly, comfortable philosophy seem to be the natural result of having himself attained the balance he so clearly explains in the concrete and so obviously considers necessary to life in any aspect.—F. LaMonte

Comparative Psychology. *By F. A. Moss and others. Prentice-Hall, Inc., N. Y. C.*

In recent years the number of colleges offering courses in behavior has greatly increased. Graduate laboratories have been making so many important contributions to the field that a text book summarizing these recent discoveries has been very much desired. At last twelve eminent students of animal psychology have coöperated in producing a work which is both stimulating and authoritative. Naturalists will be especially interested in the chapters by Doctor Stone of Stanford University on motivation of animal behavior and the maturation of instinctive functions. They will also be attracted by the chapter on social psychology by Doctor Tinklepaugh, formerly of Yale University. Moreover, they will find a wealth of information in other chapters which could profitably be made to form a basis of their thinking when analyzing the behavior of animal life in the wild state.

Animals are often described by naturalists as being conditioned to certain stimuli. Doctor Liddell of Cornell University has reviewed in one chapter the field of conditioned reflexes, including his own important studies, and has shown that the concept has a wider application than formerly assumed. Considerable space in the book has been devoted to the problem of learning. The late Doctor Franz, of the University of California, has a chapter on the relation of learning to brain structure. Doctor Heron, of the University of Minnesota, has two chapters which give a splendid review of the forms of apparatus employed and the results secured in the study of animal learning. Doctor Tolman, of the University of California, has reviewed the theories of learning. Especially significant is his discussion of the "field theories" of learning, including the much discussed Gestalt theory.

Animal psychologists have borrowed very heavily results from the physiological laboratories. It is to be regretted that they have found so little of use from the voluminous writings of modern naturalists. The reason for this seems to be that with few exceptions naturalists have not introduced experimental methods into their studies. Until some experimental check has been made of their conclusions, the animal psychologists prefer to ignore them. It is to be hoped that the naturalists will remedy this situation by studying the data which these psychologists have presented and then show their relation to their own field. For the present the intelligence of an animal must be rated in terms of its ability to master and remember complex problem boxes or other laboratory apparatus. There are hosts of problems which the animal in nature is called upon to solve, and surely these must be taken into consideration if one is to secure an adequate picture of the animal's mental life. In brief, the book stands as a challenge to naturalists to summarize and correlate their data in order that such data may be utilized by serious students of animal behavior.

As Professor Thorndike states in the first chapter of the book, "A human mind is the product of original unlearned tendencies and the experiences of life. The former, man possesses as part of his human inheritance, just as he possesses a backbone, erect stature, small forelimbs, and a large brain . . The study of animals not only supplements human psychology and helps to solve problems arising therein: it also suggests new problems and new methods for human psychology." Doctor Tinklepaugh in his discussion of "gifted" animals adds: "Though great caution is necessary in the interpretation of animal behavior, Morgan's Canon has led to anthropomorphic phobia that have no place in scientific psychology. The discovery of a type of behavior in animal that is present in man seldom justifies redefining and renaming the behavior of the animal on the *a priori* basis that animals are incapable of behavior at such a level." For example, frequent reference is made in the book to the recent discoveries of insight or reasoning in lower forms. It was not so long ago that only man and the apes were supposed to be capable of sizing up a situation at a distance and coming to a conclusion on the basis of the relations of the objects one to another. Again only recently it was taught that kinaesthetic or muscle sense was the chief sensory modality employed in maze learning, but the new data show " . . . that the best explanation . . . is that the maze habit is controlled by some sort of central mechanism that will function independently of all sensory cues." Even in many of the lower animals " . . . learning appears to involve something more than the mere formation of new stimulus-response connections or the stamping in and stamping out of old ones. The final response in all such cases appears rather as in some degree independent of present stimuli, and as controlled in part by temporarily absent, or by indirect, relatively distant features of the total situation."

Briefly, the recent discoveries in animal psychology have shown that the mind of animals is more like that of man than has been hitherto supposed. The textbook which these twelve psychologists have produced will be of great service not only to the student of animal behavior but also to the naturalist and nature lover who wishes a summary of the recent discoveries in the field of animal psychology.—G. K. NOBLE

HOW TO RIDE YOUR HOBBY. *By A. Frederick Collins. D. Appleton-Century Co., New York. 298 pp., $2.*

ANYONE who may believe that collecting stamps, coins, or autographs practically exhausts the possibility of a hobby for the average person, will be greatly enlightened by a perusal of *How to Ride Your Hobby* by A. Frederick Collins. Since new economic conditions tend to give business men and women more and more leisure time, the book is especially timely.

Mr. Collins has compiled an exhaustive collection of things to do for pleasure that should suggest a hobby to anyone who is interested in finding one. He does not attempt to give detailed information about each occupation—just enough to catch the imagination and start the interested reader on the path of research. It is pleasing to see that a considerable number of ideas have been included that are in the line of nature study and scientific work.
—D. L. E.

RICHARDS CYCLOPEDIA. *Edited by Ernest Hunter Wright and Mary Heritage Wright, 24 vo. in 12 books, pp. 6540. J. A. Richards Inc., New York, 1933.*

WITH the publication of *Richards Cyclopedia* comes a new meaning to the old verse, "The world is so full of a number of things, I think we should all be as happy as kings." This set of twenty-four volumes bound into twelve books gives a colorful and interesting picture of important information in the fields of human endeavor and knowledge, including history, art, science, industry, travel, exploration, government, economics, invention, and biography.

A library of such a scope sounds pedantic and heavy, but this set of books is designed not only for reference, but also as an "adventure story." Never is the reading dull, never obscure, never stereotype.

A child would find nothing irksome or hard to understand, nor would an adult find anything to affront a sophisticated intelligence. Its 6540 pages radiate clarity and charm, and the 12,000 illustrations would delight even the least visual-minded person. Many of these illustrations are taken from American Museum material and will serve to disseminate the importance of Museum groups and exhibits in the inventory of human knowledge. In addition to the many four-color plates there are 164 pages of maps printed in six colors, including a complete atlas of the world. An excellent bibliography of readable and authentic books, including the author's name, the age level to which the book is adapted, the name of the publisher, and the price will be found to be of invaluable assistance to parents, teachers, and librarians.

A new and rather unique arangement has been used in the compilation of this cyclopedia. Long articles, such as "The Magic of the Camera" or "The Story of the Sea," have been divided into chapters which are printed all in one volume but with various unrelated subjects interspersed between them. The purpose of this is to enliven the interest in one comprehensive subject by cutting it to bits and serving it to the reader on a silver platter of imaginative captions. In the "Story of the Weather," for example, the first chapter commands our curiosity by the captions, "How the Weather Makes History—We have learned to outwit the weather, though we should never have become civilized men without its whims"; and the next chapter on the weather reads, "An Ocean of Air—Floating in thin substance that we cannot see, we get all our weather from it"; and still a later chapter is headed, "Blow, Winds, Blow—The breezes that fan our farms and cities are just as useful as those that bring the sailors home from the sea." At the beginning and the end of these separate chapters will be indicated to the reader the page from which the story was continued and on what page the next chapter will be found, though for a child's mind one short exciting phase of the subject may suffice his curiosity. The entire story can be found without further reference to an index and without taking another volume from the shelf. Although I can appreciate the advantages of this curious arrangement for an immature mind unable to focus attention on one subject through the entire treatment of that subject, nevertheless I find it a bit disconcerting to have my "Story of the Weather" punctuated by articles on the "History of France" and the "Art of Swimming."

The importance of *Richards Cyclopedia* as a distinct contribution to modern educational methods cannot be overstressed. It is tangible evidence that the fields of learning can be translated into a popular and dramatic story, dignified, accurate, and equally helpful to young and to old.

—Agnes G. Kelly

Recent American Museum Publications

NOVITATES

No. 815. Variation in Pacific *Trachurops Crumenophthalmus*. By J. T. Nichols.

No. 816. The Tiffany Fauna, Upper Paleocene. II. Structure and Relationships of *Plesiadapis*. By George Gaylord Simpson.

No. 817. The Tiffany Fauna, Upper Paleocene. III. Primates, Carnivora, Condylarthra and Amblypoda. By George Gaylord Simpson.

No. 818. Occurrence and Relationships of the Rio Chico Fauna of Patagonia. By George Gaylord Simpson.

BOOKS *by* MUSEUM AUTHORS AND OTHERS *of* GOOD STANDING

for sale by THE AMERICAN MUSEUM OF NATURAL HISTORY

Ackerson, Mary C.	The Frog Book	$5.00
Akeley, Mary Jobe	Carl Akeley's Africa	5.00
Andrews, Roy Chapman	Across Mongolian Plains	5.00
	Ends of the Earth (1st edition 1929)	4.50
	Ends of the Earth (Star edition)	1.00
	New Conquest of Central Asia. Vol. 1. Natural History of Central Asia	10.00
	On the Trail of Ancient Man	6.00
	Whale Hunting with Gun and Camera	5.00
Andrews, Roy Chapman and Yvette Borup	Camps and Trails in China	5.00
Anthony, H. E.	Field Book of North American Mammals	5.00
Armstrong, Margaret	Field Book of Western Wild Flowers	3.50
Averill, Mary	Flower Art of Japan	3.00
Bartlett, "Bob"	Sails Over Ice	3.00
Beebe, William	The Arcturus Adventur	7.50
	Beneath Tropic Seas	3.50
	(Blue Ribbon edition)	1.00
	Galapagos, World's End	6.00
	Jungle Days	3.00
	Nonsuch—Land of Water (Blue Ribbon edition)	1.00
	Pheasant Jungles	3.00
Beebe, William and Tee-Van, John	Field Book of the Shore Fishes of Bermuda	3.50
Berkey, Charles P. and Morris, Frederick K.	Geology of Mongolia. Vol. II. Natural History of Central Asia	10.00
Brand, A. R.	Songs of Wild Birds. (Has two phonograph records, songs of 35 birds)	2.00
Breder, C. M., Jr.	Field Book of Marine Fishes of the Atlantic Coast	3.50
Burdsall, Richard L. and Emmons, Arthur B., 3rd	Men Against the Clouds	3.50
Carnochan, F. G. and Adamson, H. C.	The Empire of the Snakes	2.50
Carr, William H.	Glimpses of Familiar Birds	1.00
	The Stir of Nature	2.50
Chapman, Frank M.	Autobiography of a Bird-Lover	3.75
	Bird-Life	4.00
	Bird Studies with a Camera	3.00
	Camps and Cruises of an Ornithologist	4.00
	Color Key to North American Birds	4.00
	Handbook of Birds of Eastern North America. 2nd Revised Edition 1932	5.00
	My Tropical Air Castle	5.00
	Our Winter Birds	2.00
	The Travels of Birds	.76
	What Bird is That?	1.50
Clark, James L.	Trails of the Hunted (First Edition)	4.00
Coates, C. W.	Tropical Fishes for a Private Aquarium. (Tropical Fishes as Pets)	$2.00
Curran, C. H.	The Families and Genera of North American Diptera	7.50
Curry, Manfred	Beauty of Flight	3.50
Ditmars, Raymond L.	Confessions of a Scientist	3.50
	Reptiles of the World	5.00
	Strange Animals I Have Known (Blue Ribbon edition)	1.00
	The Reptile Book	5.00
Durand, Herbert	Field Book of Common Ferns	2.50
	Field Book of Wild Flowers and Ferns in their Homes and in our Gardens	3.50
Eddington, Sir Arthur	New Pathways in Science	3.00
Gleason, H. A.	Plants of the Vicinity of New York	1.65
Grabau, Amadeus W.	The Permian of Mongolia. Vol. IV. Natural History of Central Asia	10.00
Grant, Madison	Passing of the Great Race	3.50
Gregory, William King	Man's Place Among the Anthropoids	2.50
	Our Face from Fish to Man	5.00
Grenfell, Sir Wilfred	The Romance of Labrador	4.00
Haring, H. A.	The Slabsides Book of John Burroughs	2.50
Herrick, Francis Hobart	Wild Birds at Home	4.00
Holland, W. J.	The Butterfly Book	10.00
	The Moth Book	5.00
Jeans, Sir James	Through Space and Time	3.00
Johnson, Martin	Cannibal-Land	1.00
	Congorilla (Blue Ribbon)	1.00
	Lion	5.00
	Lion (Blue Ribbon edition)	1.00
	Safari	5.00
Jordan, David Starr and Everman, Barton	American Food and Game Fishes	5.00
Knight, Charles R.	Before the Dawn of History	2.50
Kunz, George F.	The Magic of Jewels and Charms	8.50
	Rings for the Finger	8.50
LaMonte, Francesca and Welch, Micaela	Vanishing Wilderness	2.50
Lederer, N.	Tropical Fish and their Care	2.50

BOOKS *by* MUSEUM AUTHORS AND OTHERS *of* GOOD STANDING

for sale by THE AMERICAN MUSEUM OF NATURAL HISTORY

Lindbergh, Anne Morrow	
North to the Orient	$2.50
Loomis, Frederic Brewster	
Field Book of Common Rocks and Minerals	3.50
Lorimer, Frank and Osborn, Frederick	
Dynamics of Population	4.00
Lowie, Robert H.	
The Crow Indians	4.00
Lutz, Frank E.	
Field Book of Insects	3.50
Mann, Paul B. and Hastings, George T.	
Out of Doors. A Guide to Nature	2.00
Mason, Gregory	
Columbus Came Late	4.00
Mathews, F. Schuyler	
Field Book of American Trees and Shrubs	3.50
Field Book of American Wild Flowers	3.50
Field Book of Wild Birds and Their Music	3.50
McKready, Kelvin	
Beginner's Guide to the Stars	1.25
McSpadden, J. Walker	
To The Ends of the World and Back. Scouting for a great Museum (The American Museum of Natural History)	3.00
Mead, Margaret	
The Changing Culture of an Indian Tribe	4.50
Coming of Age in Samoa	3.00
(Blue Ribbon Edition)	1.00
Growing Up in New Guinea	3.50
(Blue Ribbon Edition)	1.00
Sex and Temperament in Three Primitive Societies	3.00
Means, Philip Ainsworth	
Ancient Civilizations	7.50
The Fall of the Inca Empire	4.50
Medsger, Oliver P.	
Nature Rambles Spring	2.00
" " Summer	2.00
" " Autumn	2.00
" " Winter	2.00
Moates, Leone and Alice Leone	
Off to Mexico	4.75
Morden, William J.	
Across Asia's Snows and Deserts	5.00
Morris, Earl H.	
The Temple of the Warriors	5.00
Murphy, Robert Cushman	
Bird Islands of Peru	6.00
Nichols, J. T. and Breder, C. M., Jr.	
The Marine Fishes of New York and Southern New England	1.40
Noble, G. Kingsley	
The Biology of the Amphibia	5.00
Olcott, William T.	
Field Book of the Skies	3.50
Osborn, Henry Fairfield	
Cope: Master Naturalist	$5.00
Creative Education in School, College, University and Museum	2.50
The Earth Speaks to Bryan	1.00
Evolution of Mammalian Molar Teeth	2.75
Evolution and Religion in Education	2.00
Fifty-Two Years of Research, Observation and Publication, 1877-1929	1.50
From the Greeks to Darwin	2.50
Impressions of Great Naturalists	2.50
Man Rises to Parnassus, 2nd Edition	3.00
Men of the Old Stone Age, 3rd Edition	5.00
The Origin and Evolution of Life	4.00
Outhwaite, Leonard	
Unrolling the Map	3.75
Peattie, Donald Culross	
Singing in the Wilderness	2.50
Pope, Clifford H.	
The Reptiles of China. Vol. X. Natural History of Central Asia	10.00
Prince Nyabongo	
The Story of an African Prince	3.00
Rogers, Julia	
The Tree Book	5.00
The Shell Book	5.00
Reeds, Chester A.	
The Earth Our Ever-Changing Planet	1.25
Robertson-Miller, Ellen	
Butterfly and Moth Book	2.50
Schwesinger, Gladys C.	
Heredity and Environment	4.00
Simpson, George Gaylord	
American Mesozoic Mammalia	5.00
Attending Marvels. A Patagonian Journal	3.00
Stefansson, V.	
The Friendly Arctic	6.50
My Life with the Eskimos—New and Abridged Edition	2.50
Stetson, Harlan T.	
Earth, Radio and the Stars	3.00
Man and the Stars	2.50
Stevens, Bertha	
Child and Universe	3.75
Thomas, William S.	
Field Book of Common Gilled Mushrooms	3.50
Thomson, J. Arthur	
The Wonder of Life	5.00
Vanderbilt, William K.	
Across the Atlantic with *Ara.* Summer 1924	5.00
15,000 Miles Cruise with *Ara.* 1927	5.00
Taking One's Own Ship Around the World	30.00
To Galapagos on the *Ara*	30.00
West Made East with the Loss of a Day	20.00
Wa-sha-quon-asin (Grey Owl)	
Pilgrims of the Wild	3.50
Wissler, Clark	
The American Indian	5.00
Introduction to Social Anthropology	3.50
Man and Culture	2.75
Relation of Nature to Man in Aboriginal America	3.50

Address orders to The Book Shop

THE AMERICAN MUSEUM OF NATURAL HISTORY
77th STREET AND CENTRAL PARK WEST :: :: :: NEW YORK, N. Y.

Remittances must accompany all orders—Include 10 cents per volume for postage

THE WILSON H. LEE COMPANY
ORANGE (NEW HAVEN), CONN.

CHILDREN'S BOOKS *by* MUSEUM AUTHORS *and others of good standing*

for sale by THE AMERICAN MUSEUM OF NATURAL HISTORY

Abbot, Charles Greely	
Everyday Mysteries	$2.00
Akeley, Carl and Mary Jobe	
Lions, Gorillas and Their Neighbors	2.50
Boy Scout Book of True Adventure	2.50
Bronson, Wilfrid S.	
Fingerfine	2.00
Paddlewings	2.00
Cory, Harper	
Animals All	1.75
Disraeli, Robert	
Seeing The Unseen	2.00
Ditmars, Raymond and Carter Helene	
The Book of Zoögraphy	2.00
Douglas, Robert Dick, Jr., Martin, David R., Jr., Oliver, Douglas L.	
Three Boy Scouts in Africa	1.75
Ewers, Hanns Heinz	
The Ant People	3.00
Fabre's Book of Insects	2.00
Fisher, Clyde and Langham, Marion	
Nature Science:	
Book I. World of Nature	.96
Book II. Ways of the Wild Folk	.96
Book III Our Wonder World	.96
Book IV In Field and Garden	.96
Green, Fitzhugh	
Roy Andrews—Dragon Hunter (A book for boys about Dinosaurs and Bandits)	1.75
Harrington, Isis L.	
Komoki of the Cliffs	1.20
Hillyer, V. M.	
A Child's Geography of the World	2.00
Hornaday, William T.	
Tales From Nature's Wonderlands	$2.50
Johnson, Gaylord	
The Stars for Children	1.50
Johnson, Osa Helen	
Jungle Babies	1.75
Maeterlinck, Maurice	
The Children's Life of the Bee	2.00
Mann, Lucile Q.	
From Jungle to Zoo	2.00
Mann, Paul B., and Hastings, George T.	
Out of Doors, A Guide to Nature	2.00
McCreery, James Lindsay	
Exploring the Earth and Its Life	2.00
Patch, Edith M.	
Holiday Hill	2.00
Holiday Pond	2.00
Patch, Edith M., and Fenton, Carroll Lane	
Holiday Shore	2.00
Robinson, W. W.,	
Animals in the Sun	2.00
Stefansson, Vilhjalmur and Violet Irwin	
Kak	1.50
Verpilleux, E. A.	
Picture Book of Houses	1.00
Washburne, Carleton and Heluiz	
Story of Earth and Sky	3.50
White, Stewart Edward	
The Magic Forest	1.00
Wilwerding, W. J.	
Jangwa—The Story of a Jungle Prince	1.75

Address orders to The Book Shop

THE AMERICAN MUSEUM OF NATURAL HISTORY
77th STREET AND CENTRAL PARK WEST :: :: :: NEW YORK, N. Y.

Remittances must accompany all orders—Include 10 cents per volume for postage

NATURAL HISTORY

URNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

FIFTY CENTS DECEMBER 1935

A Travel Certificate
I I A T
Merry Xmas

This Year

GIVE TRAVEL!

. . . to your children
. . . to your relatives and friends
. . . to employees
. . . to everyone who ever dreamed of travel

THIS CHRISTMAS, be different! Give Travel through I. I. A. T. Travel Certificates (obtainable at Travel Agents) and watch the eyes of your family and friends light with joy. For everyone wants to travel...and Travel Certificates give them their chance.

Think of it! For $3.50, $5.00, $10.00 (or any amount up to $500.00) you can give a gift that will be enthusiastically received by young, old, every type and temperament, every kind of people in every walk of life. And whether for $3.50 or $500.00 Travel Certificates come in the same beautiful and impressive Xmas Gift Envelope, inscribed with your name as the donor and the name of the recipient.

A practical, personalized, sure-to-be-appreciated present that brings with it these other rewards:

1. *A year's free subscription to TRIPS ($4.00 yearly)*
2. *Discounts at smart New York shops, restaurants, etc.*
3. *A secured Travel fund in a solid Bank, member of the Federal Reserve System.*
4. *A Gift as good as Gold, that can be cashed in if desired.*

Start someone on the road to Travel and let them continue with 50 cent Travel stamps.

Be Santa with Travel in your pack!

The coupon is your Xmas list. Fill out and mail or call at your Travel Agents and your Yuletide gift problem is solved!

INTERNATIONAL INSTITUTE FOR ADVANCEMENT OF TRAVEL, INC.
565 FIFTH AVENUE NEW YORK, N. Y.

I. I. A. T., 565 Fifth Avenue, New York, N. Y.

Please open______Xmas Travel Certificates for $________each and send to me in the beautiful Xmas Gift Envelope for inscription. I am attaching names and addresses of those for whom I am opening Certificates. I enclose:

☐ *Check* ☐ *Money Order* ☐ *Will pay Postman*

____

____

N. H. ________________________

50
TRAVEL STAMP
Go! ON INTERNATIONAL TRAVEL STAMPS

"NATURAL HISTORY" illustrations are printed from Sterling engravings. Advertisers, publishers and printers commend Sterling photo-engravings for their excellent printing qualities and faithfulness to original copy.

Color Process—Black and White—Ben Day—Line

STERLING ENGRAVING COMPANY
304 EAST FORTY-FIFTH STREET, NEW YORK
Telephones: MUrray Hill 4-0715 to 0726

You can believe these Fish Stories

The World of Fishes

by WILLIAM KING GREGORY
and FRANCESCA LAMONTE

The jumbled confusion of fishes reduced to a few simple, comprehensive groups.

Everyday fishes treated as living engines
Flying fishes as gliders
Fantastic deep-sea fishes
Parental care in fishes
Evolution of fishes in Geologic Time

90 pages, 18 illustrations. Paper bound.
Price 30 cents post-paid

Address orders to THE LIBRARY

THE AMERICAN MUSEUM OF NATURAL HISTORY
77th Street and Central Park West, New York, N. Y.

ALL PAYMENTS MUST BE MADE IN ADVANCE

NATURAL HISTORY

The Journal of the American Museum of Natural History

VOLUME XXXVI ★ ★ ★ ★ DECEMBER 1935

Polar Bear of the Arctic .... *Cover Design*
From a Drawing by George F. Mason

Henry Fairfield Osborn (1857-1935) .... W. K. G. 370

An Equatorial Wonderland .... Joseph R. Slevin 374
The Galápagos—A Country of Great Volcanoes, Giant Tortoises, and Flightless Birds

The Golden Diggers .... Roy L. Abbott 389
Wasps That Make Remarkable Provision for Feeding Offspring That They Will Never See

The Ancient Buried City of Kentucky .... Lorine Letcher Butler 398
A Recently Discovered Stage in the Unfoldment of American Civilization

Attacking Ocean Problems .... George L. Clarke 405
Work on a Multitude of Unsolved Questions as Carried on by the Woods Hole Oceanographic Institution

Across Newfoundland .... Stanley Truman Brooks 417
Fine Scenery and Fine People Add Zest to a Search for Pre-glacial Fauna

A Strange Partnership .... Don H. Selchow 431
How a Bird and a Honey Badger Combine Their Efforts to Mutual Advantage

A National Park in Embryo .... C. S. Pulver 438
Approximately Five Hundred Square Miles of Territory in Southeastern Utah, Which Is Rich in Treasures of Historic Value and in Natural Beauty

Science in the Field and in the Laboratory 445
Current Events in the World of Natural History

Reviews of New Books 453
Recent Publications for Those Interested in Nature

PUBLICATION OFFICE: 246 Meadow Street, New Haven, Conn.

EDITORIAL: Edward M. Weyer, Jr., Editor; A. Katherine Berger, Associate Editor; Dorothy L. Edwards.

Manuscripts should be sent to the Editor, The American Museum of Natural History, New York, N. Y.

SUBSCRIPTIONS. NATURAL HISTORY is sent to all members of the American Museum as one of the privileges of membership. Membership Superviser, Charles J. O'Connor.

ADVERTISING: Tom Davin, Manager of Publications, The American Museum of Natural History.

COPYRIGHT, 1935, by The American Museum of Natural History, New York, N. Y.

Henry Fairfield Osborn

Educator, Administrator, Scientist, who guided the American Museum for a generation

[*This outline of Professor Osborn's life was presented at a meeting of the Scientific Staff of the American Museum of Natural History, November 7, 1935. A special memorial is being planned with the collaboration of the well known scientists who have been associated with Professor Osborn. This conference covering various phases of his great life and work will be fully dealt with in a future issue of* NATURAL HISTORY.]

OUR beloved former president, Henry Fairfield Osborn, died suddenly of heart failure at his home at Garrison-on-Hudson, New York, on Wednesday, November 6, 1935, at the age of seventy-eight. It is exceedingly difficult to express adequately our sorrow in losing this steadfast friend and great leader. His human contacts were so numerous and so uniformly helpful to others that a great many people will deeply mourn for him. In fact, his good deeds on every side were so manifold that we know not where to begin. Nevertheless, we must attempt a brief outline of his life, as follows:

He was born on August 8, 1857, at Fairfield, Connecticut, the son of William Henry Osborn and Virginia Reed Sturges Osborn. His ancestry on both sides was of the best and his very able and devoted parents left nothing to be desired in the influences that moulded his childhood. While he was still quite young, his father built a smaller house, "Wing-and-Wing" (1881) near his later residence, Castle Rock, at Garrison, New York, overlooking the Hudson River, opposite West Point. In this delightful home and environment the young Fairfield early showed his interest in natural history. As a student at Princeton he came under the influence of the famous Doctor McCosh and was so much attracted by the subject of philosophy that he undertook several studies in psychology and philosophy which were published as brief papers at intervals from 1880 to 1884.

Palæontologist

Meantime, however, through Professor Guyot of Princeton, he became interested in palæontology, and in 1877 he, together with his friends W. R. Scott (who was destined to remain as his life-long colleague) and Francis Spier, Jr., organized and carried to a very successful conclusion the Princeton scientific expedition of 1877; this expedition explored the Bridger Basin in Wyoming and brought back many important specimens of new and little known Eocene mammals. From 1878 to 1880 he worked as a graduate student and (1881-1890) instructor at Princeton. In those days evolution was the burning topic of interest in all universities and before palæontology had supplied the direct evidences of evolution, embryology and comparative anatomy were looked to as its principal supports. Osborn at that time, as later, saw that all three sources of evidence should be studied together.

In 1879-80 therefore he went to England for advanced graduate work at Cambridge University with the great embryologist Balfour. Later he went to University of London, where he became the pupil of T. H. Huxley and ardently studied comparative anatomy under that inspiring teacher. We see in his early study on the foetal membranes of the opossum and other marsupials signs of his ability to choose subjects of strategic importance. The same is true of his studies on the origin of the corpus callosum of the mammalian brain; in his rather extended paper on the principal fibre tracts of the brains of amphibians he opened up a line of investigation which has been carried on by, among others, Prof. C. J. Herrick, who gladly acknowledges the importance of Osborn's pioneer studies. In fact, between 1883 and 1887, comparative neurology may be said to have been his principal subject, and with the assistance of Dr. Oliver S. Strong, he planned to write a general work on comparative neurology.

Gradually, however, his papers in vertebrate palæontology became more numerous and, after another extended residence in England, he completed his memoir on Mesozoic Mammals (1888), which again demonstrated his ability to choose a subject of major importance and to extract from it far-reaching results. For it was the Mesozoic Mammals that carried back the history of the mammalian molar teeth to a very distant date, when the triangular or so-called tritubercular molar crown was in its initial stages. He therefore endorsed Professor Cope's theory of the origin of the tritubercular molar, adding many original evidences and observations of his own and early developing an ingenious system of naming the principal cusps of the upper and lower molars, which system has since been adopted by the palæontologists of the world. While giving every due credit to Cope, he proceeded to apply his own nomenclature in detail to the complex molar patterns of ungulates and showed how, with this tritubercular key, as he called it, one could unlock and open up the most complicated molar patterns, analyzing their parts and reading the history of the group.

Zoologist

In 1891, through the coöperation of President Seth Low of Columbia University and President Jesup of the American Museum, Professor Osborn was invited to take up his residence in New York and to become, on the one hand, Da Costa professor of zoölogy at Columbia University and on the other, founder and curator of the department of vertebrate palæontology in this Museum.

At Columbia he was the leader in organizing the new department of zoölogy. With the assistance chiefly of Doctors E. B. Wilson, Bashford Dean, and Oliver S. Strong, he soon developed a very progressive and successful department. During this period he founded the Columbia University Biological Series and brought out therein his book *From the Greeks to Darwin*, which attracted wide attention. He also arranged the publication in the same series of Willey's *Amphioxus and the Origin of the Vertebrates*, *Dean's Fishes, Living and Fossil*, and Calkins' *The Protozoa*. For almost a decade he served actively as Dean of the School of Pure Science, and as the time came nearer for Columbia to move to its new site at Morningside Heights, he became responsible for the planning of the lecture rooms, laboratories, and offices of the department of zoölogy in Schermerhorn Hall, the corner stone of which was laid in 1896. Meanwhile he was conducting courses in neurology, comparative anatomy and palæontology in the department. Doctors Gary N. Calkins, J. H. McGregor, Henry E. Crampton and the present writer, all of the same department, were his own graduate students. About 1903 he began to transfer to the American Museum the greater part of the lectures and laboratory work of his graduate courses "Evolution of the Vertebrates" and "Mammals, Living and Fossil." In 1907 he handed over these courses to the writer for further development and they are still being conducted at the Museum. His regular teaching work at Columbia ceased in the year 1910, when he was appointed Research Professor in Zoölogy and generously turned back his salary into the department.

Chiefly through his efforts the Museum acquired the private collection of fossil vertebrates which had been amassed by his friend Prof. E. D. Cope of Philadelphia. He soon gathered around him an able staff: Dr. J. L. Wortman as assistant curator, Mr. Adam Hermann as chief preparator, and others. Then under his vigorous and efficient direction was begun that great series of field explorations for fossil vertebrates which has never ceased to this day. To make a very long story short, the building-up of the department of vertebrate palæontology through forty-five years of his continuous activities is regarded by some as his greatest single achievement.

He derived great inspiration and enjoyment from his numerous palæontological field trips, especially in the western states but also in Egypt and Mongolia and in his trip around the world.

At the time of his death he was the author of 940 articles, papers, books, monographs, etc., listed in his bibliography. It is obviously impossible to refer in detail to this astonishing output; but it seems very safe to state that among his most important contributions to science were the following:

1) His initial studies on the origin of the corpus callosum of the mammalian brain;

2) His memoir on the Mesozoic Mammals;

3) His numerous contributions to the study of the evolution of mammalian molar teeth to and beyond the tritubercular type;

4) His many important papers and monographs on the fossil rhinoceroses, titanotheres, horses, and proboscideans;

5) His great textbook on "The Age of Mammals."

With regard to the theory of evolution, his outstanding principles, or laws, as he called them, include the following:

1) The law of continental and local adaptive radiation;

2) The law of *homoplasy* or parallel but independent evolution in related lines of descent;

3) The law of *tetraplasy*, whereby evolution results not from the operation of single causes, but as the resultant of forces from four principal directions (external environment, internal environment, heredity, selection);

4) The law of *alloiometry*, or adaptive modification of dimensions of the skull, feet or other parts, arising independently in different lines of descent;

5) The law of *rectigradation*, or *aristogenesis;* i. e., the gradual appearance during long ages of new structural units of adaptive value, predetermined in the germ plasm and in their initial stages independent of natural selection;

6) The law of *polyphyly;* i. e., the normal occurrence of many related lines of descent, derived eventually from a common stock, but coexisting throughout great periods of time.

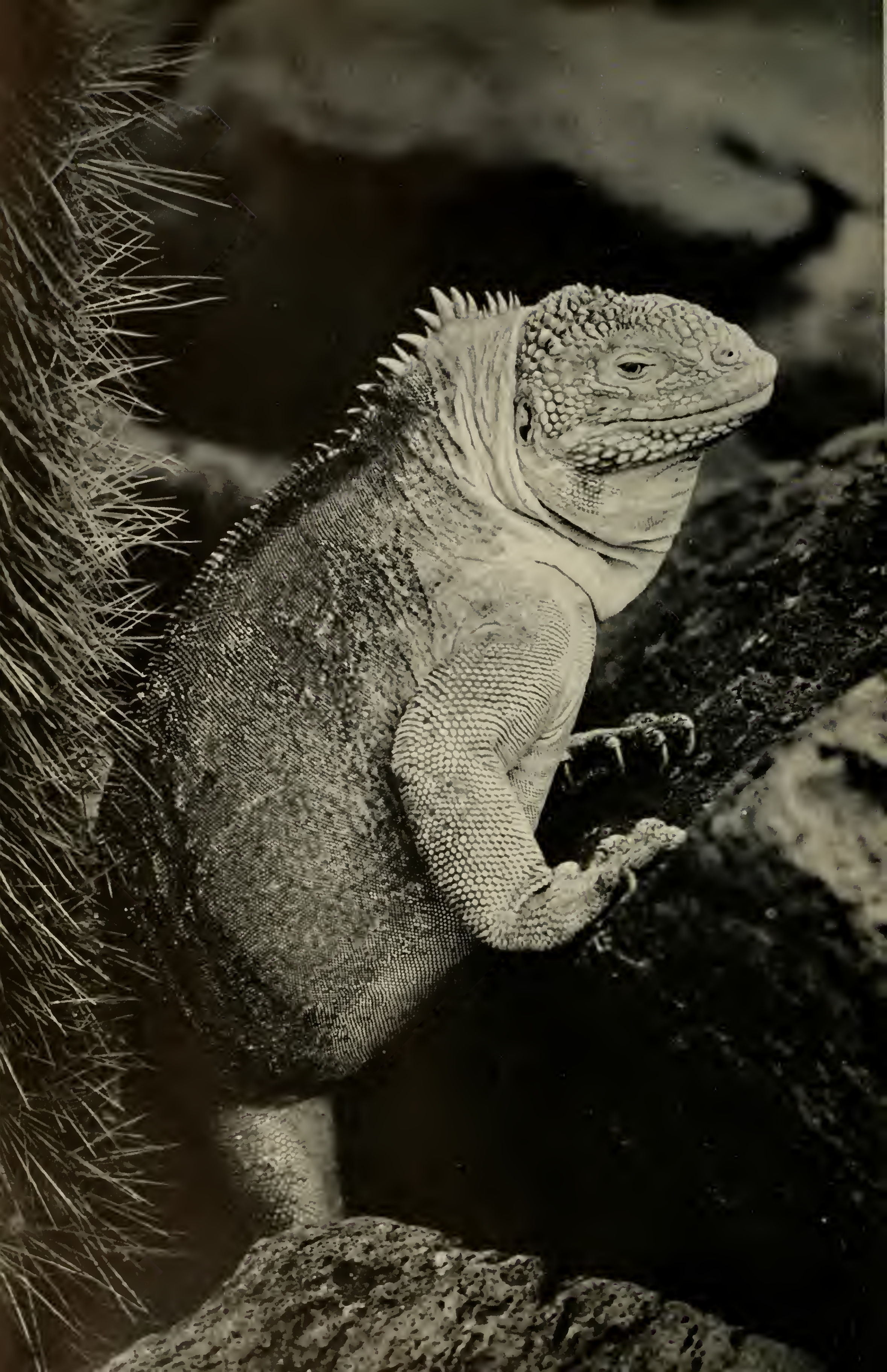
Professor Osborn's contributions to science were recognized by his election as Foreign Member of the Royal Society of London, as Honorary Fellow of a long series of other distinguished societies in Great Britain, France, Belgium, Holland, Germany, Russia, Sweden, Italy, and other countries of Europe; also of China, Persia, Argentina, Mexico, Cuba. In this country he was an active member of the National Academy of Sciences, of the American Philosophical Society for Promoting Useful Knowledge, the American Academy of Arts and Sciences, the New York Academy of Sciences and many others. He was president of the New York Academy of Sciences in 1898-99, president of the American Association for the Advancement of Science in 1928. For many years he was chairman of the executive committee and later (1909-1924) the very active president of the New York Zoölogical Society. He was the recipient of many medals awarded in recognition of his scientific labors, including the Darwin Medal of the Royal Society of London, the Wollaston Medal of the Geological Society of London, the *Prix Albert Gaudry* awarded by the Geological Society of France, the medal of the Pasteur Institute of Paris and many others.

Administrator

In 1899 Professor Osborn became closely associated with President Jesup in the administration of the American Museum and upon the death of Mr. Jesup in 1908 he was elected president of the Board of Trustees. From that day until his retirement to the position of Honorary President in 1933, he carried a vast burden upon his strong shoulders. During this period, and thanks in large part to his able leadership, many buildings were added in response to ever-growing pressure of collections and exhibits. Undoubtedly not even he could have accomplished all this if he had not budgeted his time so effectively and concentrated so intently upon one thing at a time.

On the personal side, Professor Osborn was sincere, benign, urbane, without guile, very loyal in friendship and highly appreciative of loyalty in others, extremely helpful, especially to his students and assistants. He consistently respected the right of his colleagues and assistants to differ with him in the interpretation of scientific problems.

He loved young people and delighted in furthering their education along broad and thorough lines. His wife, Lucretia Perry Osborn, until her death in 1930, was at all times a most able and enthusiastic partner. His children and grandchildren survive to cherish his memory.—W. K. G.



An Equatorial Wonderland

The Galápagos—a country of great volcanoes, giant tortoises, and flightless birds

By Joseph R. Slevin
Curator of Herpetology, California Academy of Sciences

When Dr. William Beebe wrote *Galápagos: World's End* he turned a spotlight on one of nature's outposts seldom visited by any but the whaler, buccaneer, man o' war's man, and last but not least the naturalist. Doctor Beebe's *The Arcturus Adventure* further whetted the appetite of several yachtsmen, and palatial yachts carried their owners there to have a first-hand view of this wonderland.

The Galápagos, or Tortoise Islands, furnish one of the world's last outposts where nature has, at least in part, been untouched by the hand of man, and were so named by the early Spanish explorers on account of the thousands of gigantic land tortoises which formerly inhabited them; *galápago* being the Spanish word for tortoise.

Although these Enchanted Islands, as they were also called by the Spaniards, have been a land unknown to the world at large, they have been the object of intensive study by naturalists for the past one hundred years, beginning with the immortal Darwin, whose account of his voyage on the "Beagle" has become a classic, and ornithologists look with satisfaction upon the fact that it was his observations and study of the birds that first turned his attention to the various problems of evolution.

Whether Tupac Yupanqui, the eleventh King of the Incas, when he set out to the westward to see what was beyond the horizon and to seek riches in unknown seas, was the first mariner to sight the Galápagos must always remain a mystery. The accounts of his voyage are merely legendary, the little we know about the Empire of the Incas being from traditions gathered by the early Spanish explorers.

(*Opposite page*) *Land iguana—South Seymour Island, Galápagos. Photo by W. C. Swett. Courtesy G. Allan Hancock Expeditions*

The first description

Historians are more inclined to credit the discovery to Fry Tomas de Berlanga, the third Bishop of Panama, who, in the year 1535, at the command of his king, set out on an official visit to Peru. From the account of his voyage his little vessel must have been becalmed and caught in the current setting out toward the Galápagos; and as he mentions that on landing he found enough water to fill his casks, it is probable that he visited either Charles or Chatham islands. It is from the Bishop of Panama that we get our first description of the Galápagos when he speaks of the utter desolation before him, the tameness of the birds, and giant tortoises large enough to carry a man on their backs.

After the discovery of the Galápagos by the Bishop of Panama they were visited intermittently for the next three hundred years by the early mariners and the old buccaneers, and we read of such famous men as Davis, Wafer, Dampier, and Cowley, who made the first chart of the islands, having touched their shores.

It is no wonder that the early explorers spoke of the utter desolation of these great lava piles, for such is what they really are. Great mountains of lava reach skyward, some with craters six miles in diameter, lava-flows, like huge alluvial fans, stretch from the crater rims to the forbidding shores, making the entire scene appear as a land that God forgot. But this is only one view of nature's wonderland.

Lava-flows versus jungles

Delightful sea breezes carry the moisture-laden clouds from the south and bathe the southern slopes of the great volcanoes with mist and rain, causing the higher elevations to become almost impenetrable jungles. Here rank growth covers the lava flows of past centuries, and great ferns, morning-glory vines, and the beautiful Canna leaves remind the explorer of the tropical jungles of the mainland. Below him lie great stretches of arid country, with a heavy growth of cactus, or flows of barren lava too fresh for vegetation to have gained a foothold. Perhaps the traveler may pass through a belt of tropical growth and emerge upon an open grassland surrounding a crater rim, and with blue sky above, look down on the rain clouds drenching the forest below. These are the sights that will greet only the hardy traveler, as this wonderland has not fallen entirely under the hammer of a commercial world, and it requires hard work to enjoy its marvels.

Mangrove thickets along the shores hide from view immense lagoons, veritable marine gardens not excelled in any waters, where sharks, turtles, gaily colored fish, and an abundance of marine life may be observed.

Sad to relate, the unique fauna of the Galápagos has suffered considerably and it is now in the greatest danger of extermination. If drastic steps are not taken to preserve what remains, it will go the way of the dodo and the great auk, truly a sad fate.

Situated on the equator some 650 miles off the coast of Ecuador, to which country it belongs, the archipelago extends from Lat. 1° 30′ south to 1° 40′ north and from Long. 89° to 92° west. Albemarle, the largest of the group, is about seventy-five miles in length and about forty-five in width at its widest part. Nine smaller islands and many islets, many of which are mere rocks, go to make up the remainder of the archipelago.

The islands are strictly volcanic and besides the huge craters, such as are found on Albemarle, there are innumerable minor ones. Some of these show activity at the present time, although no eruptions of great magnitude have been reported in late years. Probably the last to be reported was by Capt. Benjamin Morrell, who, when cruising about the islands in search of fur seals, observed a terrific eruption on Narborough Island in February, 1825. The heat from the eruption made the heavens appear to be one blaze of fire intermingled with millions of falling stars and meteors, and on Morrell's ship, the "Tartar," anchored ten miles to the northward of the erupting crater, the thermometer rose to 123°, causing the pitch to run from the vessel's seams and the tar from the rigging, while some of the crew complained of extreme faintness. Fortunately a light breeze sprang up and the "Tartar" got under way, sailing through the narrow strait between Narborough and Albemarle, where Morrell found the water to be 150°. Three days later, when the "Tartar" anchored at Charles Island, the crater was still shooting forth flames, appearing as a colossal beacon light and emitting a noise like distant thunder. Volcanic activity no doubt is frequent among the minor craters, especially on Albemarle and Narborough islands, and has been reported by several expeditions of late years, notably that of the California Academy of Sciences in 1905-1906, by Dr. William Beebe in 1925, and by the expedition of Capt. G. Allan Hancock in 1927-1928, when on passing Mangrove Point, Narborough Island, he observed molten lava pouring into the sea through a subterranean tunnel in the lava field.

Naming the islands

It was the custom of the early Spanish navigators to name their discoveries after the feast day on which they were made, so they gave to different islands of the archipelago such names as San Salvador, Santa Maria, San Cristóbal, Isabela, and Santa Cruz; in later years the English named them after their kings, earls, dukes, and ships of war; so, in addition to the Spanish names appearing on the charts, the English names, James, Charles, Chatham, Narborough, Indefatigable, and Daphne are given, the latter two islands being named after the British men o' war "Indefatigable" and "Daphne."

The present-day charts of the Galápagos are based mainly on the surveys of His Majesty's ships "Beagle," "Egeria," "Daphne," "Pandora," and "Sappho," the additions and corrections from year to year being furnished by visiting vessels.

As a land for colonists the Galápagos must be considered as negligible owing to the lack of soil and the great distance from world markets. Their greatest importance, other than a wild life sanctuary, lies in their geographical position in relation to the Panama Canal.

Notwithstanding the fact that the islands lie directly on the equator the climate is delightful. The cool Humboldt current, flowing from the Antarctic regions along the coast of Peru and setting to the westward when it reaches the latitude of Cape Blanco, bathes the shores of the Galápagos, creating a moderate temperature, the thermometer ranging between 70° and 80° Fahrenheit.

The prevailing winds blow from the southeast and are fairly regular from June until January, but at other times the waters surrounding the archipelago are subject to long periods of calms, and unfortunate is the vessel depending on sail alone for its motive power.

Later explorers

For much of the later knowledge we have concerning the natural history of this wonderland we are indebted, first, to Mr. Rollo H. Beck, veteran naturalist and explorer, who has made several visits to the islands, and who was in command of the expedition of the California Academy of Sciences in 1905-06, the most extensive scientific expedition ever undertaken to the Galápagos, and to Capt. G. Allan Hancock, patron of scientific activities, who, on his steamship "Oaxaca," and later his exploration cruiser "Velero III," has proved a generous host to various students eager to follow the trail of Darwin. Messrs. Templeton Crocker, Vincent Astor, and William K. Vanderbilt on their yachts "Zaca," "Nourmahal" and "Ara" have extended like courtesies, and Dr. William Beebe's writings on these Enchanted Islands have entertained innumerable book lovers.

The most curious and grotesque inhabitants of this wonderland are the giant land tortoises, huge reptiles modified for a purely terrestrial life and not to be confused with the sea turtle, a strictly marine reptile. Giant land tortoises were widely distributed over the earth during the Miocene and Pliocene periods, but the only places where they have existed in recent and historic times are on certain islands of the Indian Ocean and on the isolated Galápagos which harbor the last remnant to be found in their natural or wild state. Ideal conditions no doubt cause these tortoises to assume such gigantic proportions and individuals weighing five hundred pounds have been recorded.

The giant land tortoises

Although Fry Tomas de Berlanga on his discovery of the islands was the first to mention the presence of the giant tortoises there, it is to the English freebooter and explorer William Dampier that we owe our first extended account of these aborigines of the Galápagos. In the year 1684 he wrote "They are extraordinary large and fat, and so sweet, that no pullet eats more pleasantly." Many other of the early navigators speak of these huge reptiles, and Captain David Porter, of the U. S. Frigate "Essex," wrote "We began to lay in our stock of tortoises for which every vessel anchors at the Galápagos Islands. Four boats were despatched every morning for this purpose, and returned at night, bringing with them from twenty to thirty each, averaging about sixty pounds. In four days we had as many on board as would weigh about fourteen tons, which was as much as we could conveniently stow."

The giant land tortoises are strictly vegetarian and feed on cactus, grass, and almost any type of vegetation that may be at hand. They do not absolutely need water for their existence, but drink large quantities when it is available. The heavy showers during the rainy season fill the depressions in the soil and lava bowlders and make semipermanent water holes, enabling the tortoise to drink its fill.

In their endeavor to reach these water holes the tortoises made trails through the thick undergrowth of the jungle, tearing the vines and crushing down the vegetation with their enormous weight. Along the trails to some of the more frequented water holes the lava bowlders have been worn smooth by countless numbers of tortoises sliding over them as they went their way, and it was by following these signs that the hunters were able to locate their prey.

After drinking, the tortoise may seek the shade of some protecting bush and remain throughout the day or lie directly in the pool from which it had been drinking, provided the sun is not too warm. At times it takes a trained eye to find them, as some of the old patriarchs resemble the rocks about them, both being covered with a growth of lichens, making detection difficult.

During the breeding season, in March and April, the male tortoises become quite active and make a loud bellowing noise which can be heard at a considerable distance. The female, it is said, never uses her voice, and the male only at this particular time. The giant land tortoise is oviparous, laying from eight to seventeen white, globular eggs, with a hard, porous shell, and about the size of a billiard ball. These the female deposits in a hole dug in the soft earth, preferably along a cattle trail or in some opening, where the sun will shine upon the nest for at least part of the day. After covering the eggs with loose earth, she turns about on the nest, packing the earth down by her own weight and leaving a hard crust three or four inches thick. The natural heat of the earth then hatches them.

These huge reptiles can go for long periods without food and for this reason the whalers were able to stow them 'tween decks, where they would live for four or five months without the least nourishment. One tortoise is reported to have lived for two years in the hold of the ship "Niger," of New Bedford. It had disappeared shortly after the vessel left the Galápagos and two years later was found among some casks in the hold.

Enemies of the tortoises

The natural enemies of the land tortoises are the rats and the wild dogs, both importations from visiting ships. The rats are very numerous on some of the islands and are the greatest enemy of the newly hatched tortoises, while the dogs destroy both these and the adults. These dogs have developed wonderfully strong jaws and by breaking off pieces on the edge of the shell work in toward the flesh and tender skin, when they literally eat the tortoise out of its shell.

However, two great causes led to the near extermination of these aborigines of the Galápagos; one was the fact that they proved to be a valuable food supply for the whaling fleets of the United States and Great Britain which cruised the waters of the South Seas from 1800 to 1860, and the other was the oil hunters, by far the worst enemy, who came after the whaler's time. In the year 1793 the British Government despatched Captain Colnett on His Majesty's ship "Rattler" to report on the waters surrounding the Galápagos and to search for anchorages in the quiet waters of the archipelago where ships might haul out for repairs and cleaning. His reports were evidently favorable, for from that time on whaling fleets were constantly in Galápagos waters until the decline of the whaling industry about 1860.The captains of the various whale ships took advantage of the fact that these tortoises were an invaluable supply of fresh meat, and landing parties were sent ashore to hunt "terrapin," as the tortoises were known to the whalers. Occasionally men from these shore parties were lost and abandoned to their fate when searching parties failed to find them, their captains hoping they would be picked up by another ship.

Food value of the tortoises

Logbooks of some of the early whalers show that they took on board more than two hundred tortoises at a time, so it can be easily seen what inroads were made upon them when we consider that the fleets of both the United States and Great Britain cruised these waters for over sixty years. American whalers took more than ten thousand tortoises off the islands between the years 1831 and 1836. It is quite evident that the slaughter must have been appalling when we add to the American whalers the British whalers, men o' war, and buccaneers who frequented the islands for many years.

Some of the early navigators transplanted tortoises to other islands, notably Delano, who, in 1818 took three hundred tortoises to Mas Afuera Island off the coast of Chile, where unfortunately most of them perished. Capt. David Porter carried a number to Rotumah Island on the U. S. Frigate "Essex," where he distributed some among the chiefs and turned others loose. One of these tortoises had a particularly interesting history. In the year 1866 it was brought to Sydney, Australia, on the whaling schooner "Ida," where it lived until 1896 and then was removed to London, where it died in 1898.

The worst enemy of the tortoises, the oil hunters, carried on a ruthless warfare against all the large-sized individuals, as they possessed the greatest amount of fat. The simple equipment of the oil hunter—a few casks and a boiling pot—enabled him to move with ease from place to place, and the killing off of the tortoises in a particular locality was only a matter of days, or at best weeks. It was this that caused the appalling slaughter around the water holes and was the chief factor in their near extermination.

The sea iguanas

Next to the tortoises in the point of interest is the sea iguana, a large marine lizard, reaching a length of five feet, and the only one in the world solely dependent on the ocean for its food. It never leaves the immediate vicinity of the water and is generally found basking in the sun along the barren lava coastline, where it feeds on the sea lettuce uncovered by the outgoing tide. The sea iguana may be found individually or in pairs, or perhaps in great herds, which when moving give the impression that the ground under one's feet is in motion. Although armed with strong, sharp teeth, it is extremely docile, never offering to bite. It is abundant on most of the islands and outlying rocks of the archipelago, being most notably absent on Chatham and Charles islands, where the wild dogs have either driven it off on to outlying rocks or killed it for food.

Although an excellent swimmer, the sea iguana does not take readily to the water and, if thrown in, will immediately swim to land and climb to safety, its timidity being due no doubt to the sharks infesting these waters and which would find a sea iguana quite a tempting and dainty morsel. A somber black and red during most of the year, the iguana, during the breeding season, is covered with large blotches of green which become metallic in their lustre as the sun's rays strike them. The large conical scales on the top of the head become a pure white and the iguana is then a real study in color. The sea iguana is not eaten by the natives, but Lieutenant Shillibeer R.M., of the British Frigate "Briton," who visited the islands in 1814 says the sailors esteemed them as a most delicious food.

The land iguana, with its red body and bright yellow head and feet, is a grotesque looking creature as it sits on top of a lava bowlder, bobbing its head up and down while keeping an eye on the intruder. Too close approach will send it shuffling off with an awkward gait as it makes for the shelter of a friendly rock pile. In captivity it becomes quite docile, but on its native heath it has rather a ferocious disposition, and with its sharp tricuspid teeth and powerful jaws can bite clean to the bone, inflicting serious injury. Like the sea iguana the land iguana is a vegetarian and feeds on the leaves of the cactus and various plants that have succulent leaves, thereby getting sufficient moisture, as no water is available.

It apparently has no natural enemies, and only occasionally is it used as food by the natives; but dogs introduced by visiting ships have run wild over some of the iguana islands and have exterminated whole colonies of the animals, so that they survive in any numbers only on South Seymour and Narborough islands, where fortunately no dogs have ever been turned loose. When the famous naturalist Charles Darwin landed on James Island in 1835 during the cruise of the "Beagle," the burrows of the iguanas were so numerous that he had difficulty finding a spot on which to pitch his single tent. At the present day a few scattered and deserted burrows are all that remain to show where these great colonies had been.

Other reptile population

The widely distributed marine turtle commonly called the green turtle, the yellow-bellied sea snake, the little nocturnal lizards known as geckos, a few species of small, harmless land snakes, and the lava lizards make up the rest of the reptile population. Probably all of them would be of only casual interest to the visitor, with the exception of the lava lizards, whose tameness and curiosity might excite his wonder and attract more than passing attention. However, to the student these lava lizards are of particular interest as they furnish strong proofs regarding the formation of the archipelago and the breaking up of a single large land mass to form the group of islands that exists at the present day.

A visitor to the Galápagos will be attracted at once by the tameness of the birds; this is one of the things that so strongly attracted the attention of the Bishop of Panama on his discovery of the islands that he made mention of it in his narrative. Other early explorers made the same remarks, and Cowley, in his journal, speaks of the little turtle doves as being so tame that they alighted on the gun barrels of the sailors. The same may be said today on the islands that have been the least visited and which have been fortunate enough to escape cats and other pests that have been introduced by visiting ships.

Peculiar native birds

Although there are a few birds of brilliant plumage, such as the little vermilion fly catchers and the flamingos, most of the birds are of somber color and the gorgeous birds associated with the tropics are conspicuous by their absence. However, the peculiarity of some of the birds attracts the visitor, for nowhere else in the world is found the flightless cormorant, a large bird about three feet in height, with rudimentary wings and incapable of flight, as the name suggests, but a fast and wonderful swimmer. With a range restricted to Narborough and the northwest coast of Albemarle this bird would soon become extinct if continually molested. On land it is extremely awkward, waddling along in an ungainly fashion until hampered by rough ground or other obstacle, when it proceeds by a series of jumps until it reaches the edge of the rocks and tumbles off into the water, at once becoming a marvel of grace and speed; lucky is the fish which escapes it. Its bill is a powerful weapon of defense and one which it uses with both force and effect, being able to inflict a severe wound when the bird is thoroughly angered.

The little Galápagos penguin, about twelve to fourteen inches in height, is a never ending source of amusement to visitors, and has been carried off in considerable numbers to be placed in various zoölogical gardens. It is not so restricted in range as the cormorant, but its chief habitat is along the west coast of Albemarle Island. While on land the penguin crawls on all fours, so to speak, using both its flippers and feet, and is anything but graceful; once in the water, however, it is marvelously so and a speedy and powerful swimmer.

Thousands upon thousands of sea birds make their homes in the great bird rookeries of the Galápagos, and the man o' war birds, boobies, pelicans, gulls, etc. are a constant source of wonder to those who have never been fortunate enough to see these feathered creatures in their native haunts. The red-billed tropic or bosun bird—as it is sometimes called on account of its two long tail feathers which are supposed to resemble a marlin spike—the silken sheen of whose feathers is so admired, is a resident of many of the smaller islands, Daphne in particular, and may be found tucked away in some crevice in the rocks, probably sitting on a beautifully marked egg or protecting its young from the heat of the mid-day sun. Often it is seen high in the air in an irregular and erratic flight, its two long tail feathers clearly visible against the blue sky.

On Hood Island, the southernmost of the archipelago, is found the only known nesting site of the Galápagos albatross. As this bird is absent from the archipelago for part of the year, one wishing to see the colony at the height of the nesting season should time his arrival for about the month of June, and then may witness the curious dancing or fencing of the birds as they stand before each other bowing and rubbing their bills together in a most dignified manner.

Land birds

Of the little land birds, the mocking bird whose unbounded curiosity is astonishing, to say the least, is most amusing. It may follow an intruder around, watching every movement, and if one should stop to rest or take a noonday meal, the mocker will also halt and take the liberty of hopping upon one's foot or knee and pick up the crumbs dropped on the ground. The flycatchers also are inquisitive little fellows and can be approached quite closely without their showing the slightest fear; they may even attempt to alight on one's hat or shoulder.

In other countries hawks are considered shy birds; but not so here. To say that it is possible to approach them with impunity and push them off a limb with a stick seems to outrival some of the famous fishermen's stories; but such is the case, and we have the camera to prove it—provided you believe that cameras do not lie!! The Galápagos hawk is quite a friendly bird and at times requires considerable persuasion to make it move on.

The little Galápagos pintail, a native duck, shows little or no sign of fear and will swim calmly about, while migrant ducks will be off at the first sound of gunfire.

The great blue heron, one of the wariest of birds in northern countries, while not quite as friendly as the hawk, will nevertheless allow a close approach. It is found commonly in the lagoons in company with the flamingo and the egret. Its curiosity will sometimes lead it to follow the intruder about and perch on a near-by limb, craning its neck to see what is going on. However, the egret is far more wary, no doubt owing to the fact that it has been shot at by natives anxious to secure the beautiful plumes worn during the breeding season. These are only a few of the feathered creatures of this wonderland, and the bird-lover will find every minute spent here a pleasure and a joy to be forever remembered.

Big game fishes

As a spot for the fisherman it is not to be surpassed, for big game fish abound in the waters about the Galápagos, and fleets of tuna fishermen are almost constantly on the fishing banks in the vicinity of the archipelago. Other great game fishes such as the sail fish, sword fish, and wahoo are also to be found for the devotee of the hook and light line, while the giant mantas or devil fish resembling a huge skate and measuring some sixteen feet across will furnish sport for those who like the excitement of hunting with a harpoon. Shovel-nosed sharks, hammer-headed sharks, and the dreaded tiger shark are abundant and can furnish great sport for the angler.

Those who enjoy the beautiful in nature can spend some time about the tide pools, viewing the minute inhabitants therein. Little fish, no more than an inch in length, will be seen darting about, glistening like jewels in the blue waters and outrivaling the butterfly in variety and beauty of coloring. Minute crimson crabs, brilliantly colored starfish, to say nothing of the numberless grotesque forms of marine life will be a never ending source of wonderment to the explorer.

Although a rendezvous for whalers and buccaneers since their discovery, the Galápagos had no permanent inhabitants until about 1809, when Patrick Watkins, a deserter from an English ship, took up his abode on Charles Island; he finally escaped in a boat stolen from a vessel that had stopped to purchase some fresh vegetables from Watkins, who sold what he could to passing whaling captains. The first real attempt to colonize the islands was made in 1832, when General José Vilamil founded a small settlement on Charles Island in the vicinity of what is now known as Black Beach Roads. This colony met with little success and all that remains now to show where it had been is a great lime thicket which has covered the little plateau on the southern end of the island, a few orange trees, and the descendants of the cattle, pigs, dogs, burros, and goats, which run wild over the island. At about the same time a small settlement was on the west side of Indefatigable Island, but all traces of this, with the exception of a few agave plants, have been obliterated. The only permanent settlements for many years which still exist, are located on Chatham Island, in the vicinity of Wreck Bay, and on the southern coast of Albemarle at a point called Vilamil, named after General José Vilamil, founder of the Charles Island settlement. The former consists of a small sugar plantation, served by a trading schooner from Guayaquil; the latter is a still smaller settlement, whose inhabitants ship a small quantity of hides which they secure from wild cattle, and a few tons of sulphur a year dug from a deposit within the rim of the huge crater of Vilamil Mountain.

A few colonization schemes in late years have proved failures, and all that is left of them is the remnant of a party of Norwegians who took up their abode at Academy Bay, Indefatigable Island, where they make an attempt at drying fish in commercial quantities.

A Post Office

Despite the isolated position and the lack of population the Galápagos for many years has had a post office. This consists of a barrel mounted on top of a post and erected at an anchorage called Post Office Bay, Charles Island. When and who erected the first one is not known, but it was in existence in 1813, for it was from this post office that Capt. David Porter of the U. S. Frigate "Essex," while cruising the waters of the Galápagos in search of British whalers, found letters and papers that gave him direct information as to the enemies' ships he might expect to find.

It was the custom to deposit letters in this barrel and ships that were homeward bound would call and pick them up as they were taking departure for their home port. Often they would leave them at their first port of call if this promised quicker transportation to their destination. Thus whalers two or three years out of port were able to send news home to their owners.

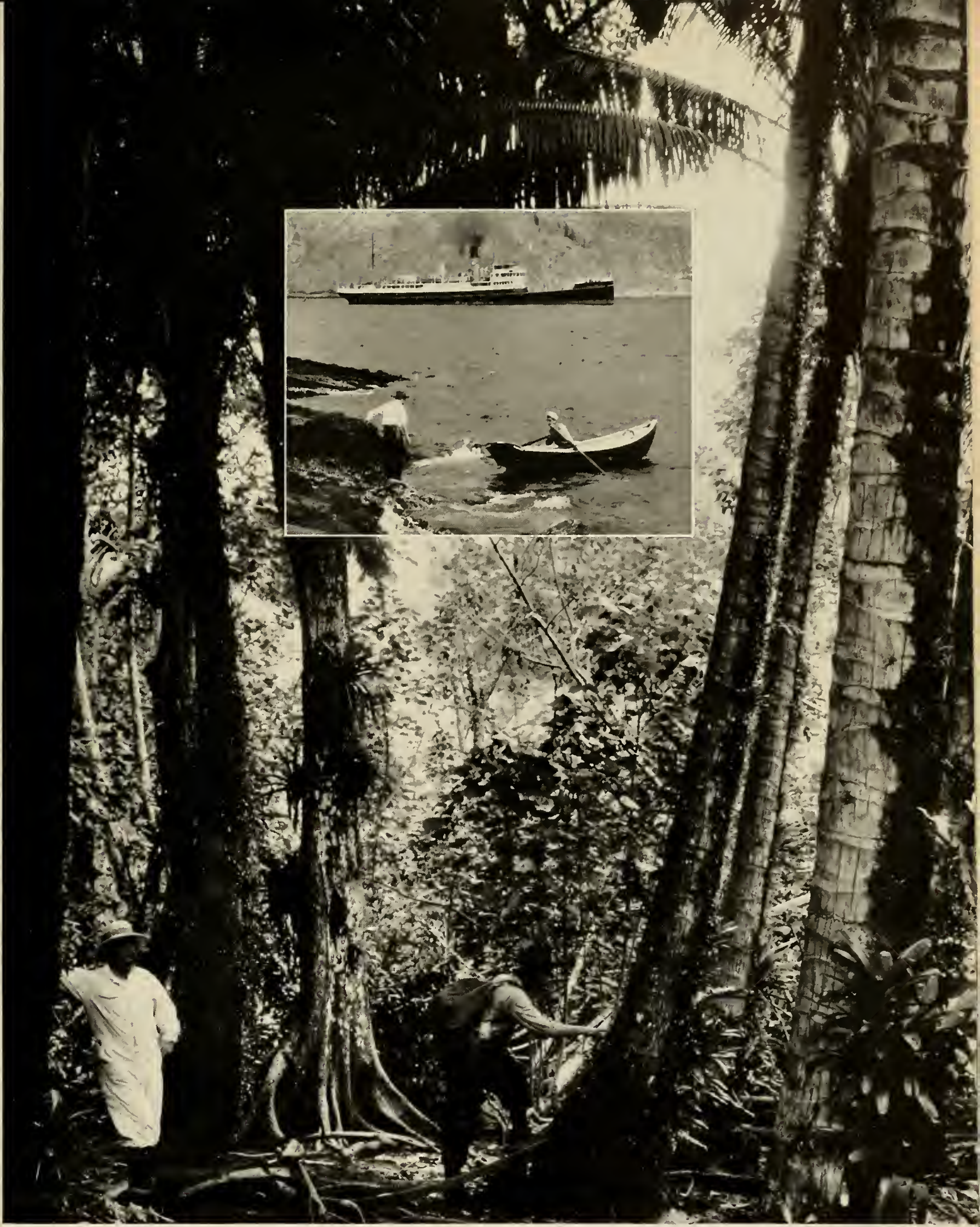
As the barrel became weatherworn and unserviceable, replacements were made from time to time by visiting ships. In 1905 an inscription on the barrel stated that it was erected by His Majesty's ship "Leander." Carved or painted on the post or barrel were the names of His Majesty's ships "Amphion" and "Virago," the French cruiser "Protet," the U. S. S. "Oregon," and the U. S. Fisheries Steamer "Albatross."

A letter's travels

When the expedition of the California Academy of Sciences to the Galápagos Islands visited this anchorage some thirty years ago, October 3, 1905, to be exact, a letter was mailed in the barrel and on the return of the expedition a little over a year later it was found that it had been picked up by the British Yacht "Deerhound," and had reached the office of the Postmaster General in Washington, D. C. At the time of mailing, the barrel was somewhat weatherworn and the rust from the hoops obliterated all of the address with the exception of two words—the surname of the addressee and the city in which he lived. The Post Office Department traced the addressee, finally delivering the letter just about a year after it was mailed. The Charles Island Post Office is still in use, though service seems to be somewhat better, the author having received a letter about six weeks after it was mailed. In this case it was picked up by the Vincent Astor Expedition on the yacht "Nourmahal," carried to Tahiti, and despatched on the regular mail steamer for San Francisco.

A plea for conservation

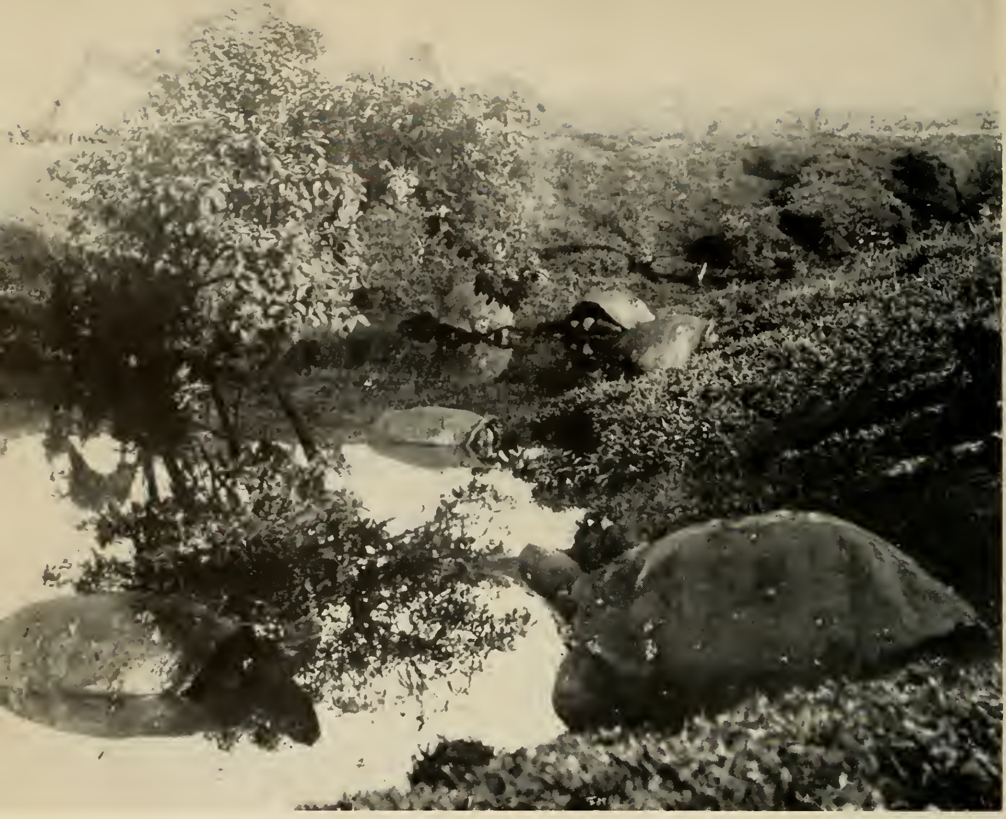
These Enchanted Islands are a land worth conserving, and as time goes on and more and more visitors become interested in seeing them, there is the greatest danger of many of the unique creatures inhabiting them becoming extinct. We have already seen the damage done in other lands by turning loose domestic animals to run wild and what has already been accomplished in the Galápagos, so let us hope that some day in the near future this may be a place set aside where nature can remain undisturbed and protected from all outside influences before it is too late.



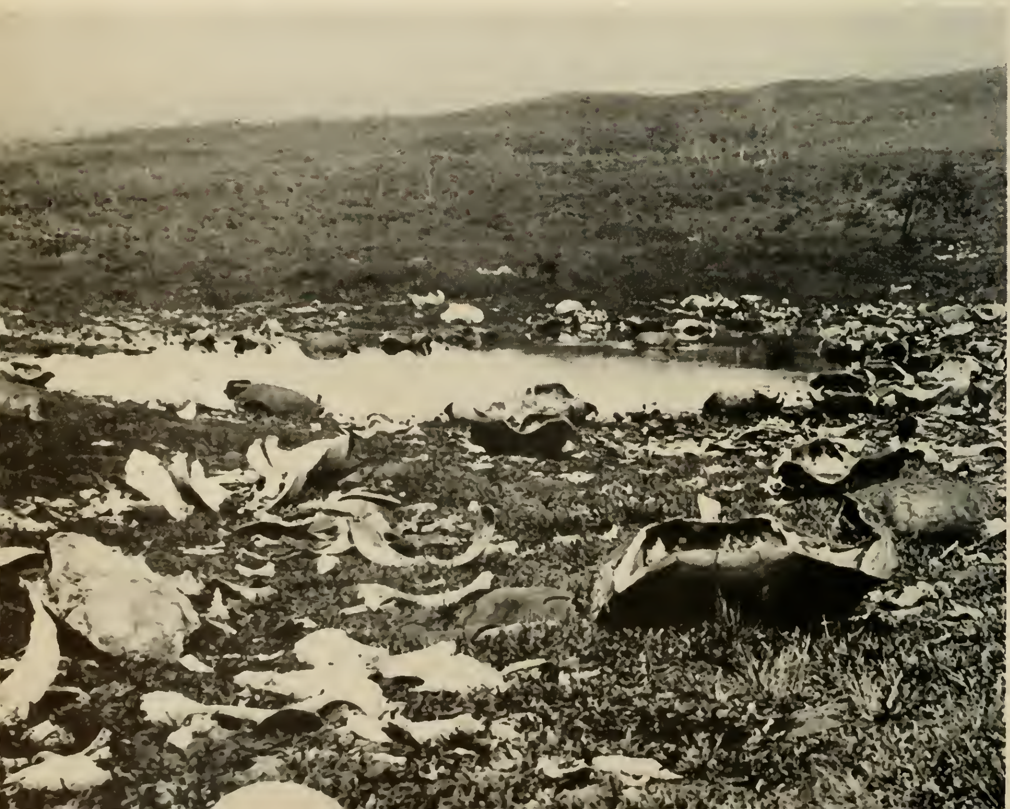
Photographs by Frank Jose

Jungle and Sea in the Galápagos

Captain Hancock, on the left, surveying the Cocos Island jungle when his first expedition to the Galápagos stopped at the Treasure Isle. This impenetrable forest covers the entire island, making exploration most difficult. In the insert above, the "Oaxaca" rides at anchor in Tagus Cove, Albemarle Island. Hancock's cruiser Valero III visited the islands later



Before the arrival of the oil hunter, these huge aborigines of the Galápagos roamed about the summit of Vilamil Mountain, Albemarle Island, and could be found around the water holes of the rolling grass lands. Below is pictured the devastation wrought by the natives in the slaughter of these harmless creatures for the few paltry pesos they received for the oil by trying out the fat. The Galápagos Archipelago is now a game sanctuary



Photos by Frank Jose

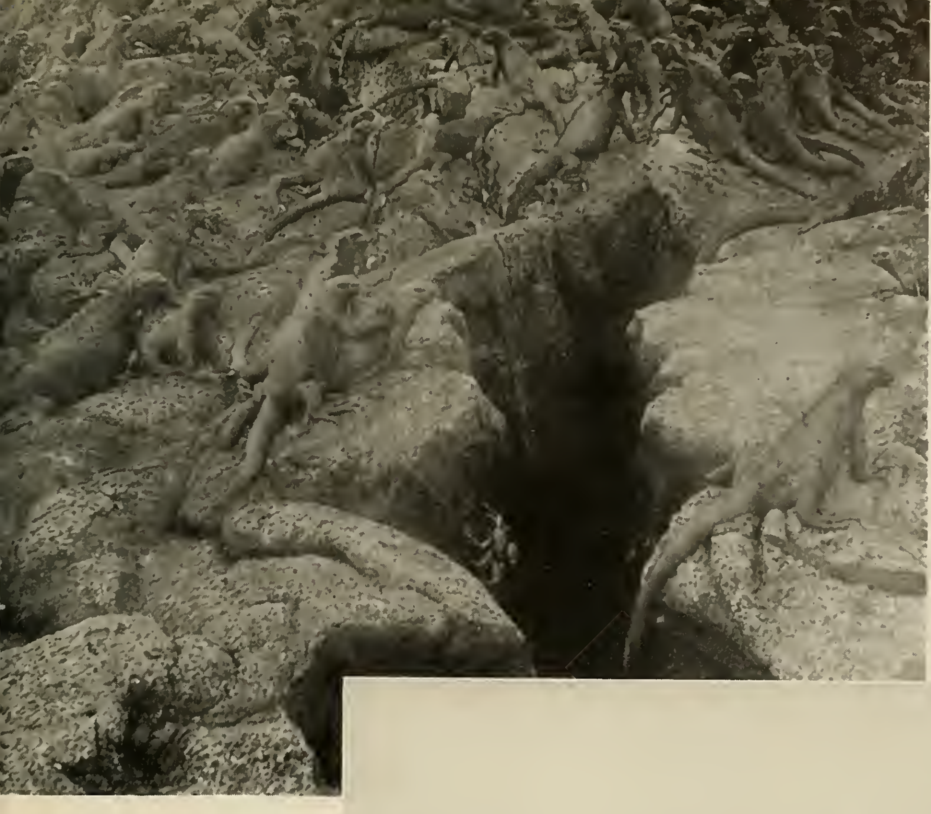
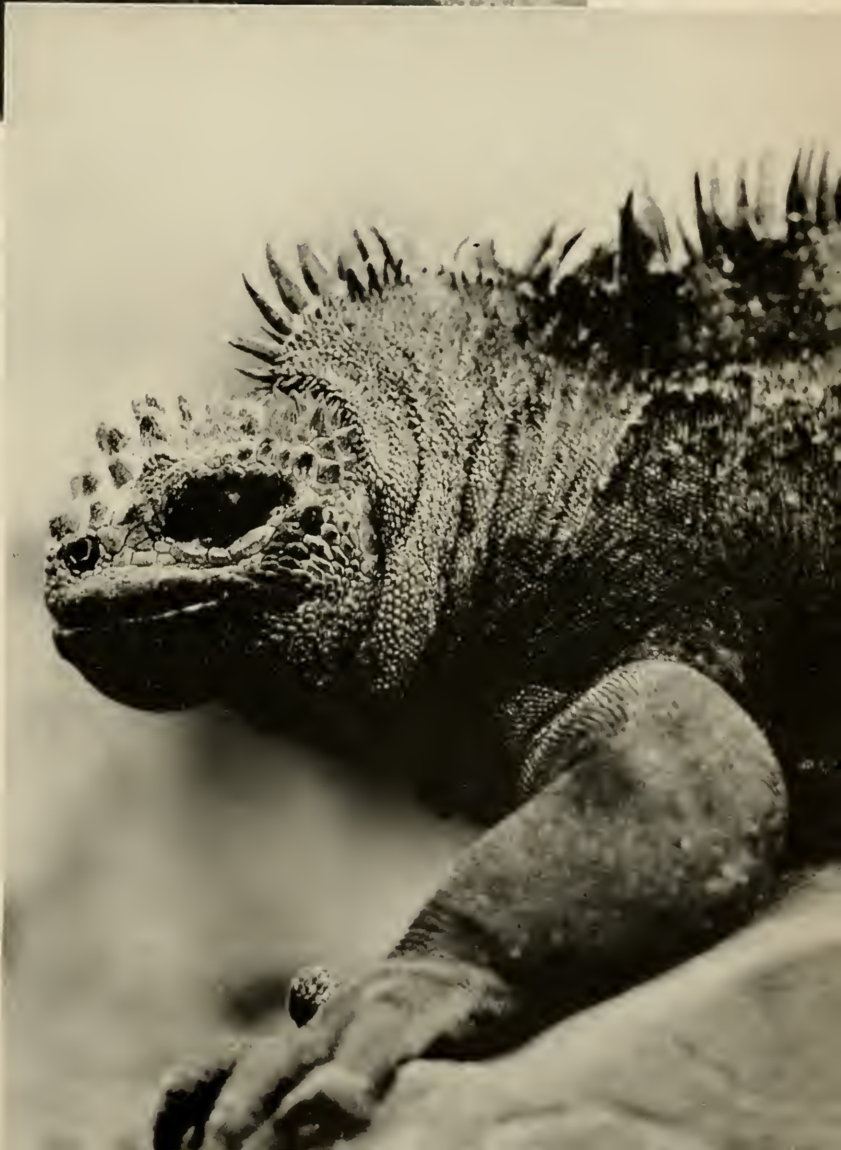


Photo by Frank Jose.
Courtesy of
G. Allan Hancock
Expedition

Because the flesh of these sea iguanas is not so palatable as that of the land iguana, and they can escape the ravages of wild dogs by taking to outlying rocks, they have survived their less fortunate relative, which is now practically exterminated on all but three of the islands



A "close up" of the grotesque sea iguana to be found on almost every island of the archipelago. Compare portrait of land iguana on page 374

Photo by courtesy
of G. Allan Hancock
Expeditions

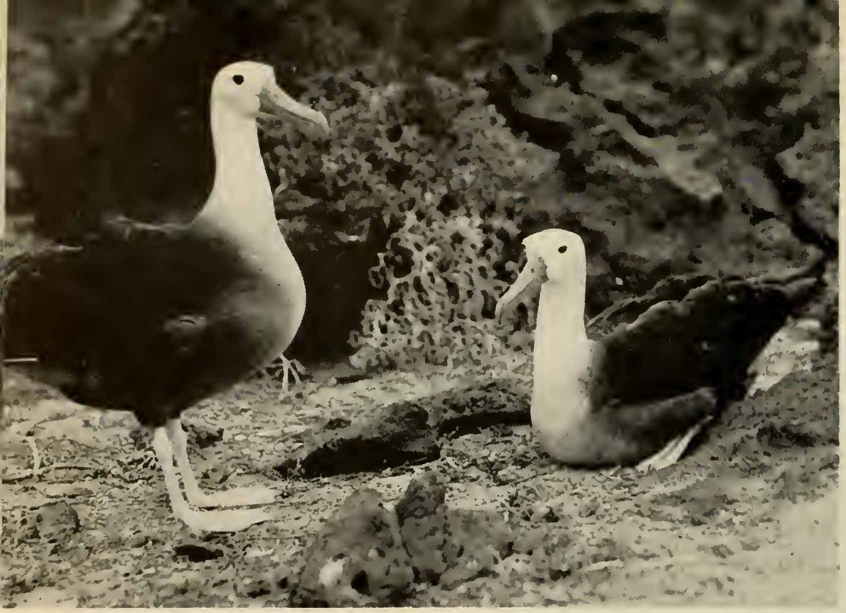
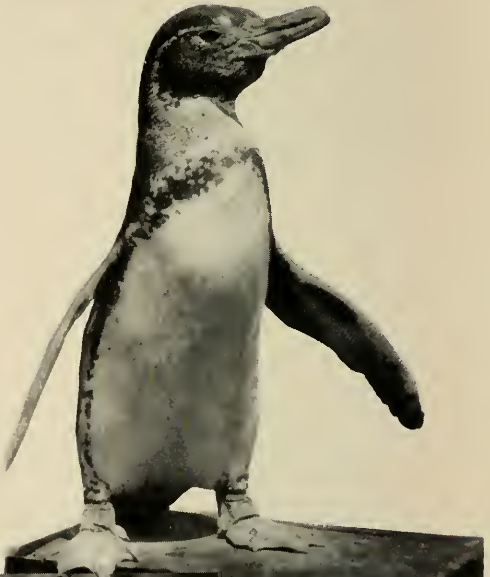


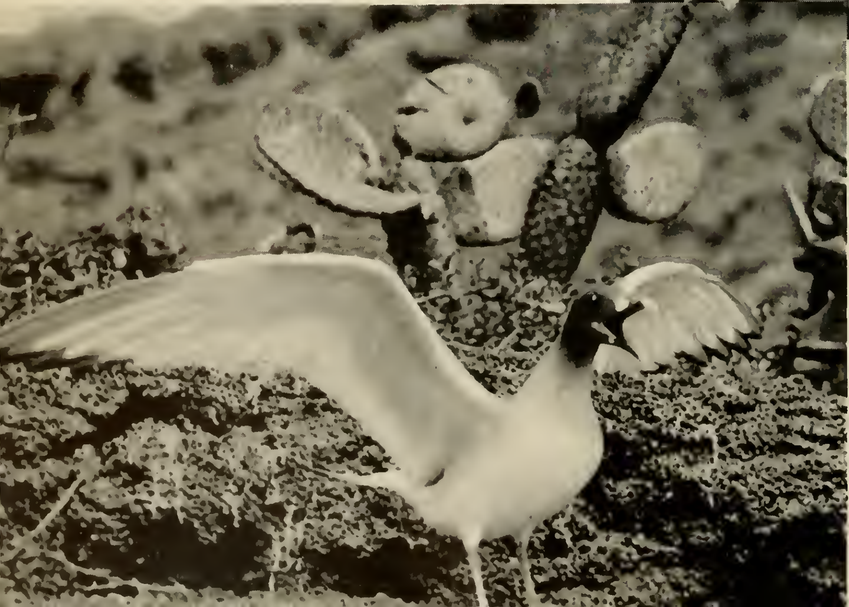
Photo by W. C. Swett. Courtesy G. Allan Hancock Expeditions

Hood Island, the southernmost of the Galápagos Archipelago, is the only known nesting site of the Galápagos albatross (Diomedea irrorata). *This beautiful bird, decidedly awkward on terra firma, is the personification of grace and beauty while on the wing*

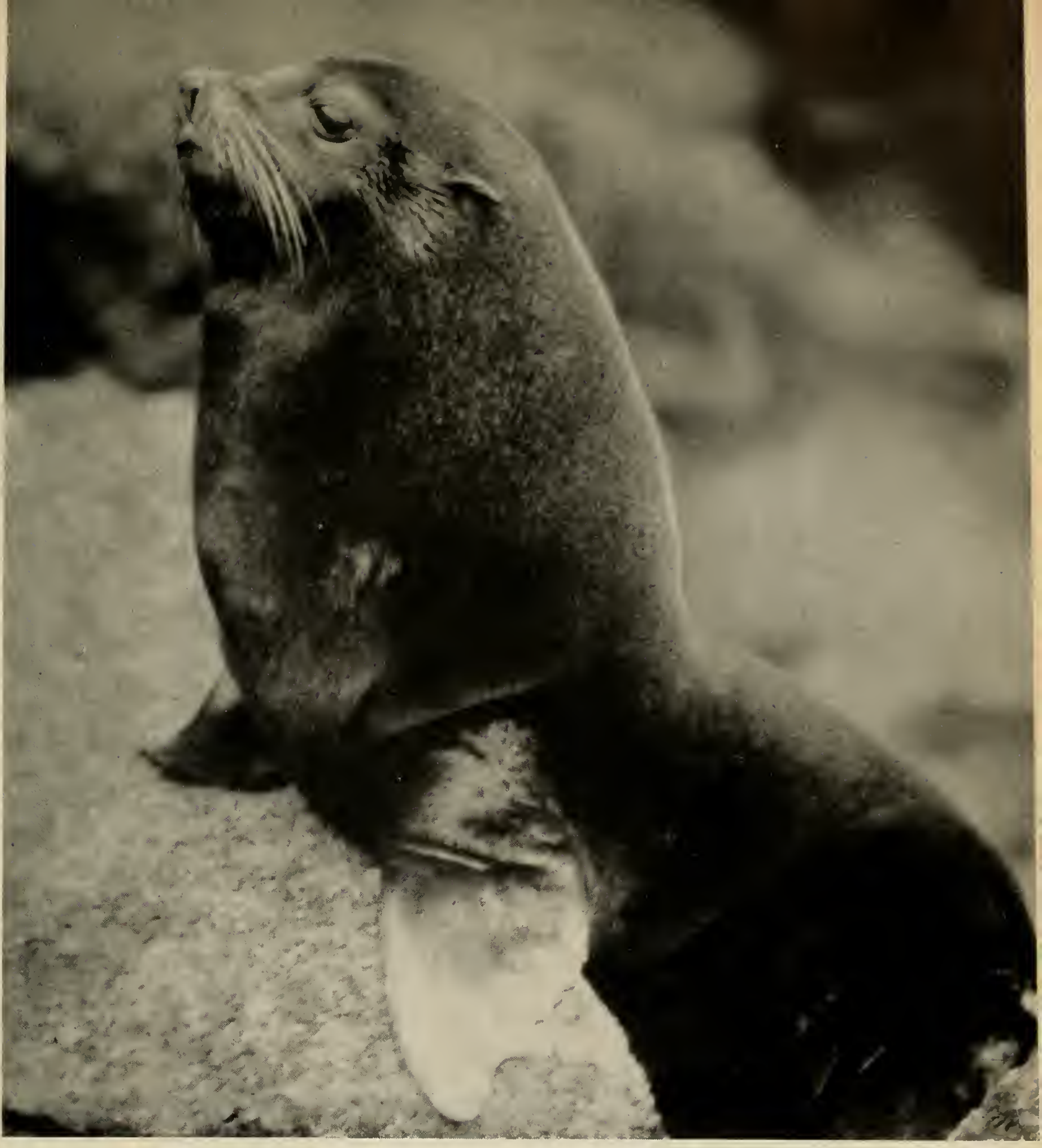


The Galápagos penguin has its chief habitat along the west coast of Albemarle Island. It is a speedy and powerful swimmer

Photo by W. C. Swett. Courtesy G. Allan Hancock Expeditions



The swallow-tailed gull (Creagrus furcatus) *may be observed on many of the islands of the Galápagos throughout the entire year. Its beautiful coloring and a conspicuous crimson ring around the eye immediately attract the attention of the visitor*

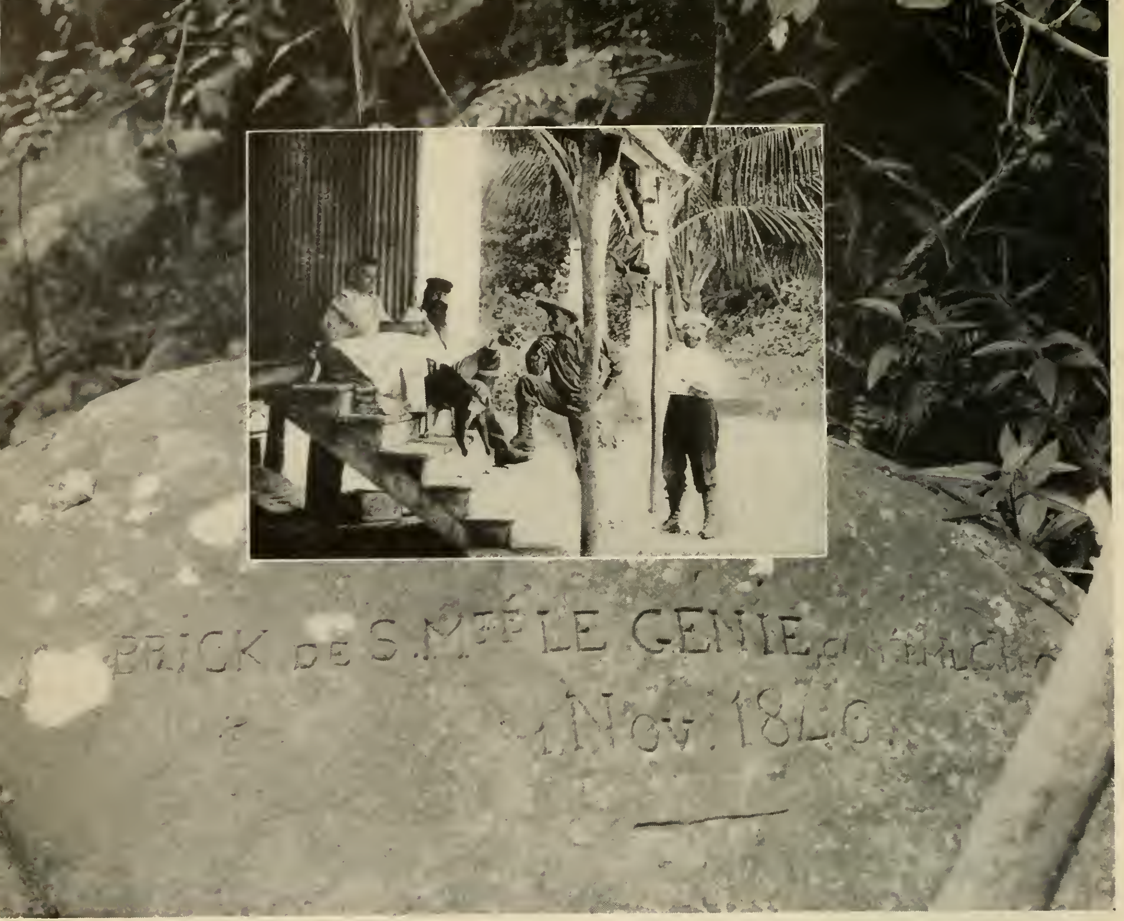


The Galápagos fur seal (Arctocephalus galapagoensis) *was almost exterminated in the early days by the sealers. It is now extremely rare and only a remnant of the once vast herds inhabits Tower Island, one of the smaller islands to the northeastward of the main group*

Photo by W. C. Swett.
Courtesy G. Allan Hancock Expeditions

This photograph of a hair seal taken at Tagus Cove, Albemarle Island, shows with what impunity the photographer may approach the animal, as it shows no fear of man

Courtesy G. Allan Hancock Expeditions



Frank Jose. Courtesy of G. Allan Hancock Expeditions

From time immemorial it was customary for sailors to leave a record of their visits to distant lands, and the rocks at Cocos Island bear testimony to the fact that it was a much frequented spot. The above inscription, at Chatham Bay, records the visit of a French brig under the command of the Count of Gueydan, November 1, 1846. The insert shows the home of Captain Gissler on Cocos Island, with the Captain, Mrs. Gissler, Rollo H. Beck, in charge of the California Academy of Sciences Expedition (1905), and J. J. Parker

Frank Jose. Courtesy of G. Allan Hancock Expeditions

A cave on the Tres Marietta Islands, on the route to the Galápagos

The Golden Diggers

Wasps that make remarkable provision for feeding offspring that they will never see

By Roy L. Abbott

Professor of Biology, Iowa State Teachers College, Cedar Falls, Iowa

It is early June. Just outside my office window along the old limestone wall of the building, there is a little plot of sandy-clay soil, grassless, weedless, baked hard by the sun. To my eye it is a desert in miniature, a dead thing; to my mind it is a spot about to spring into life, for I know that in fifty places at least, each in its tiny cell barely seven inches beneath that hard-packed soil, there is a little pulsing creature that in a few days will burst the door of its prison and come forth wriggling, clawing its way up through the soil to spread its wings in the air.

I know this because almost a year ago I saw anxious mothers laboring mightily to dig and provision the dens in which the germs of this soon-to-be risen generation were planted; because I sat in the sun for sixty days last summer by this little desert patch to learn the story I am now about to tell.

The beginning of the story

The July sun was intensely hot, and I believe I would have passed without seeing her that morning, but for the glint of the sun from her steel-blue wings. Wasps have always inspired me with a vague mixture of interest and fear, so this big black and red-brown creature pulling powerfully with her jaws at a stick larger than herself caught my attention at once.

It was a female wasp of the kind called *Chlorion,* commonly known as the golden digger. She was digging a hole in the earth about the diameter of my middle finger, and at that moment the stick was hindering her work. I stooped to watch her more closely. With a final tremendous tug, she tore the stick free, dragged it back a few inches and dropped it, giving it a strong backward kick with her hind legs as she did so. Then she raced back to her work.

She would grab a mouthful of dirt with her great jaws, support it by means of her front legs, back swiftly on her four free legs, drop it several inches from the opening, finally sending it flying by a parting kick from her hind legs. Now and then she would turn and push the dirt still farther backward with her head, something in the manner of a pocket gopher.

Hard work

Once in my eagerness to see, I bent too close. As my shadow fell upon her, she whirled quickly, turning her yellow, alert face squarely toward me, and elevating her antennæ in a warlike manner. Then she sprang into the air and circled buzzing about my head. She made no effort to sting me, however, and soon alighted again at her den. But the site she had chosen didn't seem to suit her. As if torn by indecision, she would momentarily leave her job, and race off a foot or so, making tentative bites at the soil in various places. Finally she abandoned the original site altogether, and for five minutes did nothing but dash frantically about in a wild and distracted manner, making herself a general nuisance to the thirty or forty other females like herself who were busily digging on the same plot. Once, in fact, she made the mistake of attempting to usurp the den of another wasp, but she didn't repeat the offense. The owner was upon her almost instantly, and for a moment I felt that a tragedy was imminent. Over and over they rolled in a confusing tangle of legs and bodies, but it was apparently more of a wrestling match than anything else, neither attempting to sting the other so far as I could see. Presently they untangled themselves, and the would-be usurper retreated precipitately, leaving the outraged owner standing with erect wings and heaving abdomen before her door.

But my wasp did not retreat far. Her wanderlust seemed to have departed from her and in a moment she had chosen a new site, though by what criteria I have no knowledge, and was soon digging hurriedly as before. In exactly eleven minutes she had excavated a hole as deep as her body was long, and in half an hour was down so deep that I could not see her except when she came backing out with her load of dirt.

Obstacles

Several times as she worked, I amused myself by placing obstacles in her path. She would seize these with her jaws and carry them away. One of these, a pebble of twice her weight, she carried six or more inches away, giving it a final annoyed push with her head. Once some red ants came pestering about. She ignored these for a time, but finally becoming seemingly exasperated, she sprang right and left at them and they scattered hastily as she laid two of them low with savage nips from her great jaws.

After four or five hours of steady toil, during which she had excavated fifty or sixty cubic centimeters of dirt, the nest or burrow was finished. At least I inferred this from her behavior, for she came out, wiped her antennæ, shook her wings, and seemed to go through a general tidying up process, as one might do after completing a task. She then walked briskly about the entrance for a moment, suddenly took off, and began a slow, more or less circling flight, now lower, now higher, about the entrance to her burrow, seemingly making a close observation of the landmarks by which she might know the place on her return. . . . probably getting a memory picture or making a "locality study" as some one has said.

I watched her carefully as she flew, drawing my pencil round and round on a bit of paper, attempting to trace her path, but her flight was altogether too rapid and erratic for me to obtain more than an approximate diagram of her trail. After a moment of this preliminary study, she spiraled high into the air and passed in almost a straight line out of sight. I followed her with my eye for nearly a hundred feet until she disappeared in the general direction of a weed patch.

There was then nothing to do but to wait patiently to see if she would return. While waiting, I passed the time in measuring her den by means of a broom-straw. It was approximately seven inches deep and one-half inch wide, or six times the length of her body in depth and three times the thickness of her body in width. Imagine a man digging a circular hole thirty feet deep and three feet wide in four hours! And with no tools but teeth and feet, and with no way of getting the dirt out, except by carrying it in mouthfuls and walking up a vertical wall backward. It was incredible, yet there was the ocular proof.

But Madam Wasp did not compel me to wait too long. In exactly twenty minutes she reappeared, flying heavily as if greatly burdened. She was carrying something which was hanging beneath her body like the landing gear of an aëroplane. With a great circling swoop she alighted near her den, and went waddling awkwardly up to her door, half carrying, half dragging a big green grasshopper larger than herself, which she deposited with its long antennæ almost touching the entrance. Then to my intense surprise, she abandoned her prey and went hurriedly head first down the hole. What now?

Storing the food

In a second or two she came backing out, whirled suddenly as she cleared the entrance, seized the grasshopper by the antennæ, and drew it quickly out of sight. I listened and tried to speculate on what was going on down below, but all I could hear was that same low, contented humming which she had kept up all morning even while digging hardest at her den.

In a few minutes she came out again, seemingly as fresh and alert as ever, ready for another grasshopper hunt. This time she "took off" with little or no locality study.

While she was away, I interested myself by watching the thirty or forty other wasps who were busily working around me. The following drama then unfolded before me as I sat and watched:

Some of the wasps have finished their dens and are already bringing in green grasshoppers. But each and every one behaves exactly as my wasp did with her prey. Each one drags the grasshopper up so near to the burrow that its long antennæ actually or nearly touch the entrance, each then momentarily abandons her prey to dive into her burrow on a preliminary inspection trip, each then comes backing out only to whirl quickly, seize the victim by its long rope-like antennæ, and drag it instantly out of sight. A stereotyped action! Stupid creatures, blind slaves to instinct! Each is fatally bound to behave exactly as her parents have behaved before her!

Experiments

Then a happy thought strikes me. Is this beautiful creature purely a machine? What will she do if I modify the circumstances under which she normally finds herself? What will she do if I move the grasshopper back several inches from her den? I have not long to wait for a chance to try the experiment. A heavily burdened wasp alights near by, drags her prey to the entrance, and true to form, dashes down her burrow. While she is within, I quickly pick up the grasshopper, and lay it six inches back from the entrance. What now? Out she comes backing hurriedly, whirls quickly at the mouth of the burrow, and makes a grab at empty air. What's this, no grasshopper? Why she left it there not thirty seconds before! Her expression—if an insect can be said to have expression—is comical. Elevating her antennæ, she dashes frantically about, finally coming upon her victim. Springing astride it, she waddles quickly to her den, abandons her prey, and goes down the hole. While she is within, I place the grasshopper six inches away as before. But it is of no use! Forty-three consecutive times I lay the "hopper" back, and just as often does she drag it back to the entrance, abandon it, and go in for her inspection. On the forty-fourth trip I do not move it, and she comes out and takes it in as if nothing had happened. What abysmal stupidity! She simply cannot take that grasshopper in except in her own way.

I sit and marvel upon the inviolability of instinct, then something flashes before me and my own wasp alights at her door with a grasshopper. The hunting must not have been good. . . . she has been gone an hour. But I am resolved to test her also. While she is within, I remove the grasshopper as before. Six times she obeys her instinct, but on the seventh, something happens. As if becoming disgusted with the proceedings, she marches boldly to her den and walks head first, carrying her "hopper" with her. I am astounded. She has done two new things: she has carried prey into her den without a preliminary trip of inspection, she has gone in head first dragging her prey with her—two things which her ancestors probably never did.

I wait anxiously for her next return. Has she really learned something or was her seemingly intelligent action purely an accident? Will she take the "hopper" in after fewer trials next time? She does not keep me long in suspense. In twenty minutes she is back again, and this time she carries her "hopper" in on the fourth trial. I am overjoyed! She is learning, there can be no doubt. Once again she comes with her prey, and this time she takes the creature on the second trial. How differently she behaves from the first one I tested. That wasp seemingly was dull, could not adapt herself to a new condition. This one is intelligent, adapts herself to a new condition, and more intelligently each time she meets it. Can it be that wasps, like people, show varying degrees of mentality? And will this particular one remember next morning what she learned the day before?

Further intelligence tests

But I do not test this wasp any further. The sun is getting low and she has evidently decided to quit for the day, for she comes out and begins to kick dirt into the burrow—a temporary protection for the night. I do not know where she sleeps, but at least never in the burrow, for that is usually filled at the end of each day's work. I hasten to be with her early the next morning, but somebody has unwittingly trodden upon her nest and I lose track of this particular female. There are plenty of others, however, and for the next two months I do little but apply my intelligence tests to various members of the clan.

They show great individual differences in meeting the same problem. One, for example, requires forty-five trials before taking her "hopper" in without stopping, while another takes her "hopper" in on the third trial. Several different ones take the prey in on the fourth trial, and one particularly intelligent one seemingly retains a memory until the next day. At any rate she takes her "hopper" in on the second trial one evening, and repeats the action on the second trial the next morning. But I must not forget the slower ones. One wasp makes eighteen successive trips, and then refuses to come out of her den, remaining sulking down below for more than two hours. Two others pick up their "hoppers" on the eighth or ninth trial and fly off with them and do not return.

Reactions to new problems

Noting that when left to themselves, they always drag the prey in by the long, rope-like antennæ, I try to confound them by cutting off the antennæ close to the head. But although each wasp is more or less perplexed by finding only a smooth surface where there has hitherto been a pair of convenient handles, not one is baffled by this new problem. Some, it is true, strive for minutes on end, to grasp the prey in the accustomed place, their jaws clutching senselessly at the point where the antennæ should be, before they bethink themselves to turn and seize the creature in a new place. Others sense the problem more quickly, turning after a few ineffectual nips at the head, to grip the long ovipositor, and to drag the victim by that.

But enough of such experiments. What do they mean? Simply that a wasp can modify its behavior to fit a new condition—and this statement in the face of a vast weight of scientific opinion. But whether they behave as pure automatons as many believe, or by taking thought, as my experiments seem to tell me, my wasps are always interesting. I can never be quite sure what they will do under a given condition. For illustration, after watching them for thirty days, I am positive that no wasp will ever alight with her prey and carry it into her den without a preliminary trip of inspection. "This," I say to myself "is instinct inviolate." But I am mistaken.

I am stooping in the midst of a colony of diggers, anxiously watching a large wasp's antics in trying to handle an antennæless grasshopper, when my attention is suddenly diverted by another wasp which keeps up a constant circling about my head. I notice that she is carrying a huge "hopper" and I am curious to know why she is so long in finding her nest, for usually each wasp comes with but little preliminary circling to her own door. What is the trouble? Happening to glance down, I observe that I am stooping almost directly over a freshly dug burrow. I step back instantly, and with a great swoop the tired aviatrix alights at her very door. And here I have the surprise of my life: She goes in at once, dragging her "hopper" with her. I am fooled again!

As I watch, two wasps, both carrying grasshoppers, alight near by. As they disappear below for their senseless trip of inspection, I exchange the booty. One grasshopper is three times the size of the other, surely the one wasp will object to the substitution. But I am again mistaken. Each accepts the proffered victim without a sign of hesitation. Two more bring in their prey simultaneously. I take both of these and offer them to another wasp who has just stored a victim. She accepts both in succession and without show of surprise, although here is something that never happened to her before. But she does one curious thing. On accepting the third grasshopper, she drags it to the entrance, and goes in first according to custom. Then she comes out, but instead of dragging in her prey directly, she strolls about a moment, then suddenly seizes the "hopper" and walks in with it head first. This is a new action, and so unconventional that she seems to think better of it herself, for in a moment she comes out dragging the "hopper" with her. She then stores it in the usual manner.

No respecter of her kind

Some careless person has trodden upon one of the wasps and she lies crushed, but feebly struggling near by. I pick her up and lay her at the door of another wasp that has just taken in her "hopper." The crippled wasp wriggles until her body obstructs the entrance. Then out comes the owner, springs upon the injured intruder, and after a brief struggle, picks her up and flies off with her. I lose sight of them, but in a moment she is back again still carrying the injured wasp. What will she do now? A most astonishing thing! She drags the injured one up to the burrow, goes in momentarily, then coming out, seizes the helpless creature and drags her down out of sight.

Surely she does not intend to treat one of her own kind as she does a grasshopper! Surely she will come out presently dragging the injured wasp with her. But she does not. Instead she reappears alone, dusts herself with a complacent air, and then takes off on another chase. I am again mistaken. Two days later when I dig up this den for examination, I find the injured wasp dead, but stored neatly in a cell with seven grasshoppers.

Tricking the digger

Once as I experiment in placing the prey back from the entrance, I am too slow, and the owner catches me in the act. But she pays no attention to me, merely springs upon the "hopper" and pulls strongly in the opposite direction. She evidently thinks it is trying to escape, for even as I hold the insect she stings it several times. This intimidates me, and I relinquish the "hopper." The next time I tie a string to it and when the wasp comes out, I drag it slowly away, the vexed owner following after it yards away from her den just like a dog after a bone. She is oblivious to every thing except her seemingly recalcitrant victim. She springs upon it and stings it repeatedly but she cannot stop this creature which is acting as no grasshopper ever acted before. Presently she abandons the chase, and goes off sulkily after another victim.

I repeat this trick upon another wasp. If I suddenly lift the "hopper" just as she attempts to seize it, she will spring into the air, and fly round and round my head holding the "hopper" at the end of the string. It is like flying a kite. Then she, too, gives up in disgust and goes in search of another.

A powerful huntress

How does she catch her victims? I have never seen her do this, but it is doubtless not much of a trick for my powerful huntress. Like an aëroplane from the sky she probably darts down upon the luckless grasshopper as he sits exposed on a weed stalk; a long, jabbing sting is thrust through his thin armor, and before he has time to make more than a single lusty kick or to expectorate a few drops of grasshopper molasses, he is paralyzed, seized with jaw and leg, and wafted on powerful wings into the air. In another moment he is deposited at the door of a tunnel, and in a few seconds is dragged head first down into the depths.

But what does my golden digger want with the grasshopper? She, herself, is no meat-eater. If I open one of these subterranean dwellings and see what disposition has been made of the victims I shall perhaps find the answer. It is no easy task, but I mark out a space around the hole, fall to work with chisel and spade, and in an hour have cut out a solid cube of earth fifteen inches on each edge. This I carry to my laboratory where I can examine it without injury to its contents. I have chosen a den which is still in the provisioning process, hence, the main tunnel is wide open. I place a broom-straw down this to guide me should I accidentally fill it with dirt, and with a feeling somewhat akin, perhaps, to that of an archeologist knocking at the tomp of a Pharaoh, I carefully begin my excavations.

The nest

I first make a section through the nearly vertical shaft, and find that it ends blindly seven inches below the surface. It is empty, and the soil seems hard-packed. What! Have I chosen an unprovisioned nest, or has some marauder despoiled the place before me? But no, I cannot be mistaken! Not less than twenty grasshoppers have I watched disappear down that dim passageway, and nothing has stolen them I am sure. They must be there! So I search carefully, and soon find a cylindrical column of softer earth leading off nearly at right angles to the main shaft. Ah! I have it now. My probing forceps have disclosed an oval cavity about the size of a pigeon egg, and packed full of green grasshoppers. A veritable sarcophagus! Carefully I lift them out, and lay them in a row, two males and ten females.

The great French naturalist, Fabre, says that the digger wasps he studied always chose female grasshoppers as prey, but here is proof that such is not the case with my wasps.

But male or female, these "hoppers" are here for one purpose, to serve food for a young wasp. Where then, is the heir to all this provender? Carefully, I search among the victims, and on the breast of one, near the front legs, and at right angles to the body, I find a white cylindrical egg nearly a quarter of an inch long. It is not more than half a wheat grain in bulk; the twelve grasshoppers are in comparison to it, a veritable mountain of flesh!

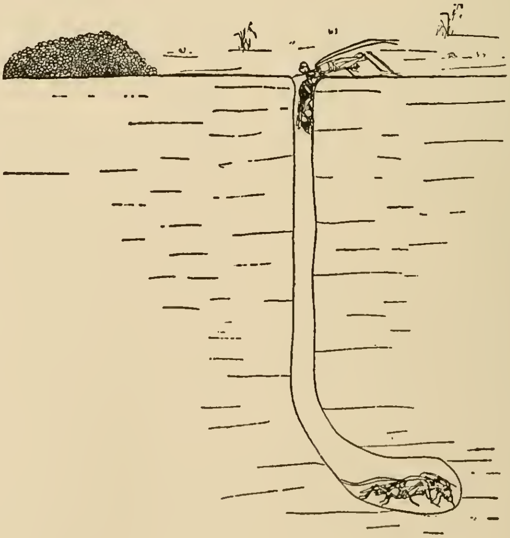
Yet from this tiny, pale blob of living stuff will come a monstrous, feasting, battening thing that will transform the whole of the twelve into itself!

Suspended animation

As I examine the victims, one of them moves! I look more carefully, and I find they all can move! I place one out in a tumbler on my desk and it remains alive for ten days. I have been mistaken. A sarcophagus? No. This is no house of the dead. It is a veritable Sleepy Hollow of Rip Van Winkles. But with one difference—these "Rips" will never waken; they have unwillingly partaken of euthanasia. The poisonous sting of their captor has rendered them helpless, but not dead. Their jaws and legs wiggle feebly, but can offer no defense against the fat grub which will soon feast upon them. Being thus alive, they will not putrefy, remaining fresh meat for this creature which is on its way to become a wasp. All it needs to do now is to eat to satiety, lay on fat, and go through the transformations Nature has fatally blocked out for it, becoming at last a wasp which will dig its way out into the air.

Fruits of labor

All this which I have been telling took place during July and August of last year. Ten months have now passed, and the summer sun is once again shining intensely upon that small plot of hard-packed soil. The rains and snows of the past year have leveled away all signs of the dens, but they and their occupants are still there. In a few days now these occupants will come forth to disport themselves carelessly for awhile in the sun. The males will fertilize the females, and then disappear to live a care-free, monastic life until they die in the fall. No family burdens for them! But upon the egg-bearing females will now come a powerful urge. Each will begin digging as if her very life depended upon it. Each will sink at least half a dozen shafts deep into the soil, fill them with grasshoppers, and deposit an egg within each shaft. All this for the sake of offspring that she will never see—just as her mother did for her. For this is the way of the diggers.



THE GOLDEN DIGGER'S BURROW

Representing Chlorion ichneumoneum, *her burrow, and her prey—a grasshopper. This sketch is from "Wasp Studies Afield," by Phil and Nellie Rau*

Wasp Food Chambers

From Hutchinson's "Animals of All Countries"

There are many kinds of wasps besides the golden digger that provide fresh animal food for their offspring, choosing, according to their species, beetles, locusts, crickets, flies, spiders, and caterpillars as provisions

At the right is an ichneumon wasp which has just emerged from its cocoon in the skin of a caterpillar victim

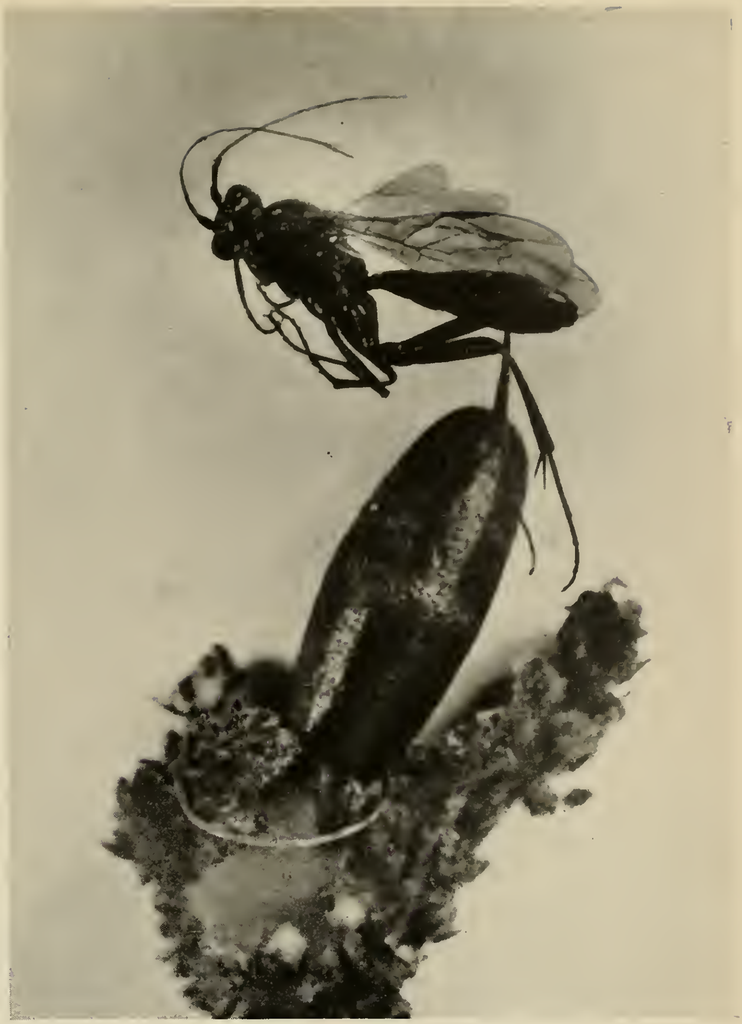
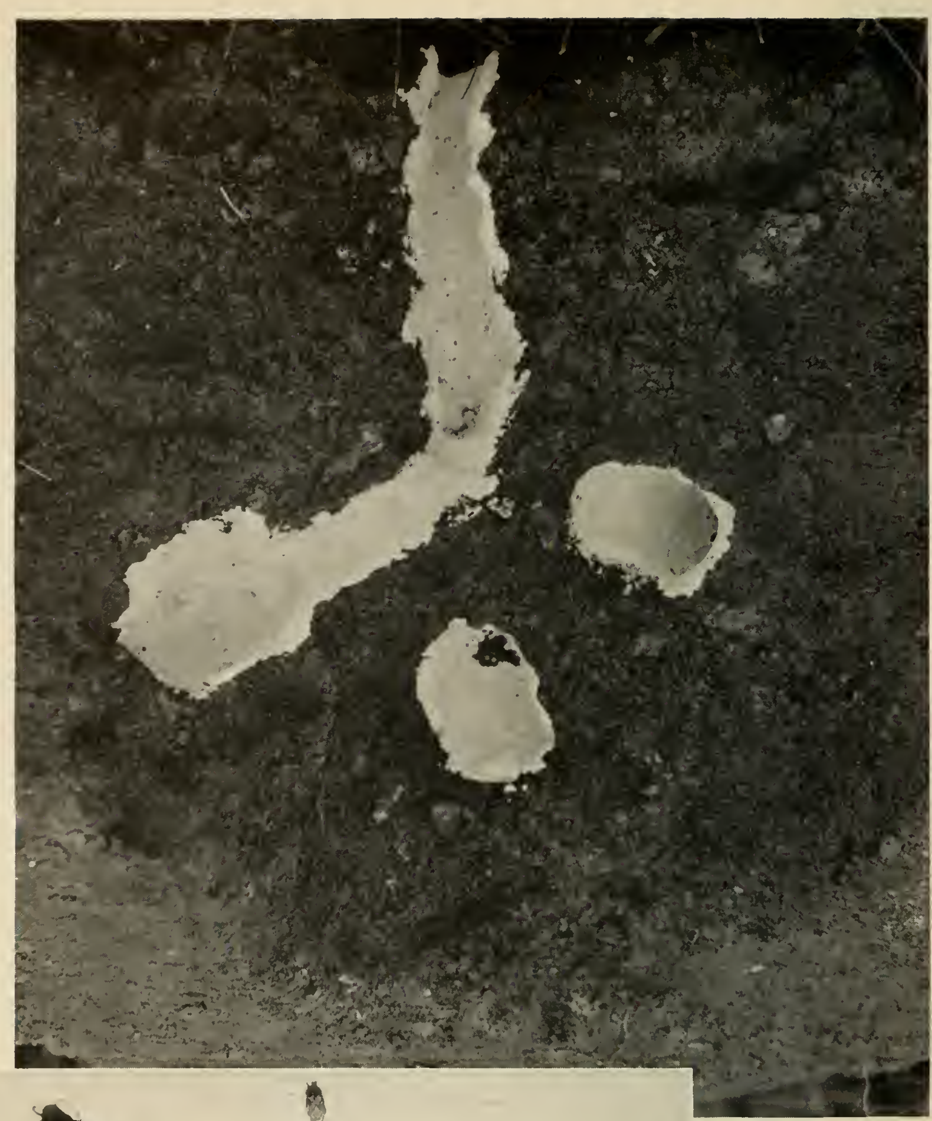


Photo by H. A. Riebe

Within the white circle is a golden digger dragging a bit of grass from her path. The burrow may be located by the weed stalk thrust into it. Note the large pile of earth (upper right) excavated by the wasp

Photo by
H. A. Riebe



Vertical section through the nest of a golden digger, showing the main tunnel and three cells at the sides and bottom

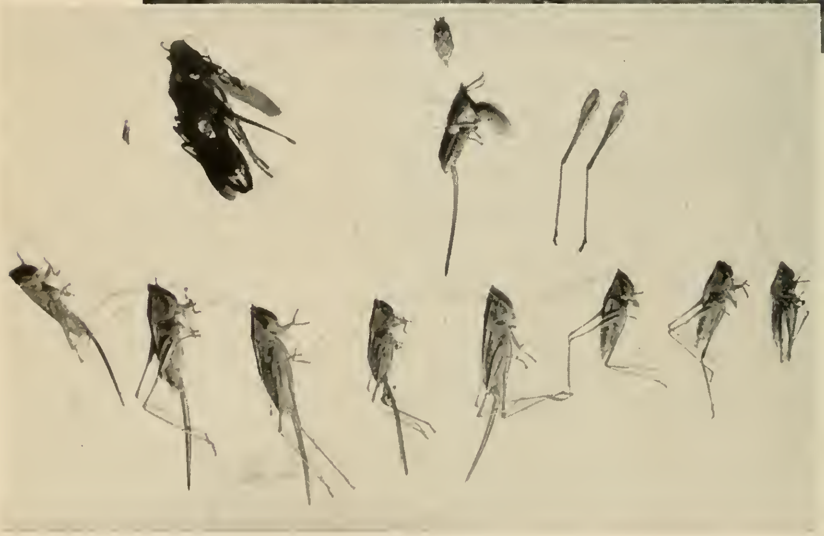


Photo by H. A. Riebe

The contents of one cell. Note the wasp larva (upper center) feeding on a grasshopper

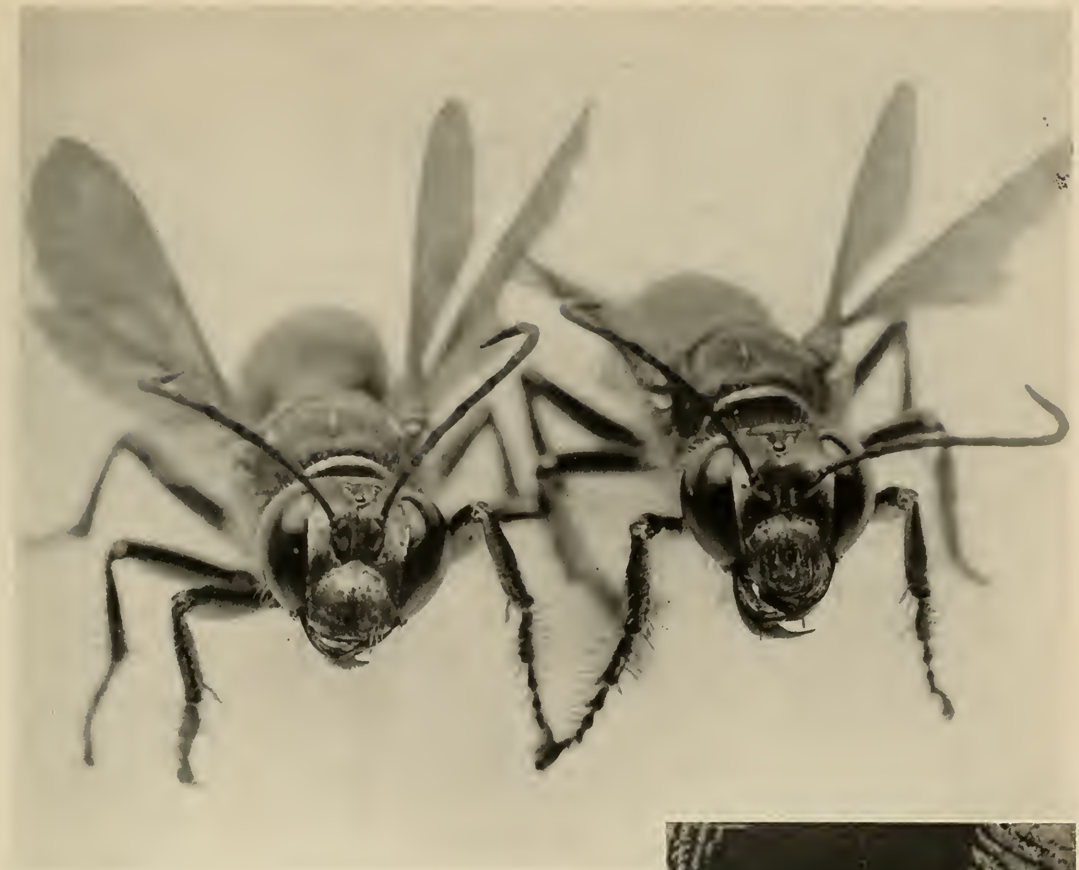


Photo by Cornelia Clarke

A "close up" of two golden digger wasps, giving a detailed view of the powerful jaws

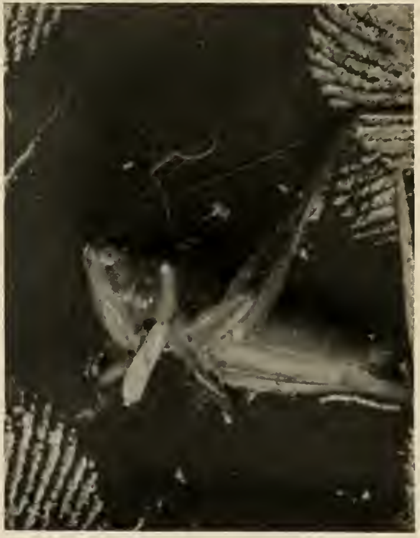
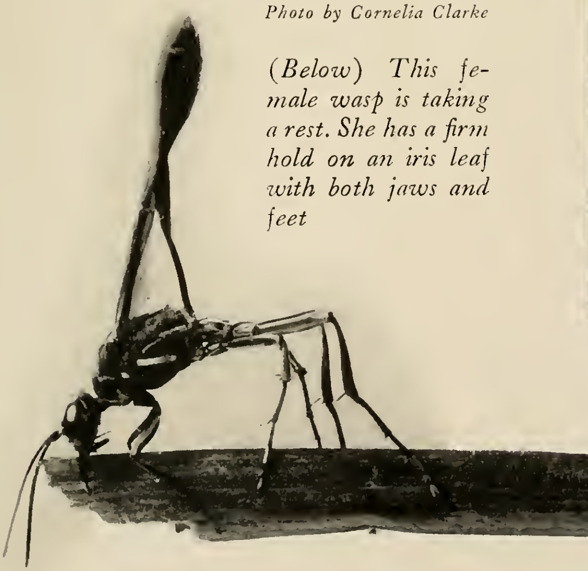


Photo by H. A. Riebe

Attached to the thorax of this female grasshopper is the egg of a wasp

Photo by Cornelia Clarke

(Below) This female wasp is taking a rest. She has a firm hold on an iris leaf with both jaws and feet



The Ancient Buried City of Kentucky

A recently discovered stage in the unfoldment of American civilization

By Lorine Letcher Butler

The motorist traveling along U. S. Highway 60 through Kentucky, will note among the signs beside the road pointing this way and that—to Louisville, Henderson, Paducah, and points south—another sign fresh and up-to-date as the rest, that reads, "The Ancient Buried City."

Following the direction indicated by its sharpened end, he continues along the modern paved road past fields and woodland, through towns and villages and cross-roads hamlets, now and then coming upon a sweeping view of the Ohio River as it hurries to keep its rendezvous with the Mississippi, and so on into Paducah and beyond, to Wickliffe.

A sleeping city

Just before reaching Wickliffe he passes Future City, and a short distance farther, West Future City. The distinction seems to be that Future City has a dwelling attached to its store, while West Future City has only a store. Through the sleepy village of Wickliffe and a turn to the right—and the traveler enters a city that is asleep, the Ancient Buried City that has been asleep perhaps a thousand years or more. And he feels a bit like a modern Æneas as he explores this city of the dead.

The Ancient Buried City of Kentucky holds the remains of a people who vanished before America had been discovered by the civilized world. Abundant evidence of these people has been found through the Mississippi Valley in the mounds which they built and which frequently yield archæological treasure. The Ancient Buried City is important among such remains first because of the proof it furnishes that it was once a commercial city of importance, and second, because of the clues it yields respecting the religious and ceremonial customs of the Mound Builders.

History in kitchen middens

In all the relics of the Mound Builders that have been unearthed no single bit of writing has been found. But their history is written in the earth—the soil and its content—the minerals, rocks, and the charred wood and bones—kitchen midden.

Situated at the confluence of the Ohio and Mississippi rivers, on a bluff overlooking this mighty mingling of waters, no better site could have been selected for a commercial center. The two great waterways afforded communication over a wide area, and travel by water was quicker and safer than over foot trails.

The Mound Builders were a sedentary people, but the commercial contacts of the Ancient Buried City were wide. This we know from the minerals and objects found in connection with the burials. There is a conch shell from the Gulf of Mexico. There is copper from the Lake Superior region, mica from North Carolina, fluor spar from Illinois, and lead which may have come from Missouri. The fine workmanship of some of the articles fashioned from these materials indicates that their civilization was of a high order.

There are nine mounds in the group that constitutes the Ancient Buried City. Three are partly excavated and work on the fourth has been begun. The largest is the Burial Mound, the excavation of which has revealed one hundred and fifty three burials; and when completed, there is reason to believe that there may be as many as one thousand. The other two works represent a temple and a council house, or chieftain's dwelling, respectively. Buildings about forty feet square have been erected over the excavated portions to protect them from the weather, and as one approaches the Buried City, the group, together with other buildings that serve as office and laboratory, also cottages for visitors, presents the appearance of a neat little summer resort.

Gazing backward into Time

But when one enters the doorway to the Burial Mound, he leaves the Present behind, and awe-struck gazes backward into past centuries. At his feet lie the skeletal remains of one hundred and fifty three persons who lived on this particular portion of the earth ages ago—just how many ages the archæologist has not yet determined. Efforts are being made to establish the exact period of their flourishing by a comparison of the tree-rings of timbers of ancient buildings found in the mounds with the living trees in the region. The oldest living tree found thus far dates from 1300, yet does not seem to compare in age with the buried trees.

Beside each skeletal person lie the articles with which he was buried—the ornaments or implements with which he started his journey into Eternity. Water bottles from which he might quench immortal thirst. Whistles for calling—what? Tools that might be useful in that strange country whither he was bound. And from these concomitants of death we know that the Mound Builders, like most primitive peoples, believed in a very material life after death.

From the nature of the articles it is learned that these people possessed a keen artistic sense. The coincidence of certain designs occurring in the work of the Mound Builders and of the Mayans even indicates a possible connection between these peoples.

The pottery of the Burial Mound is symmetrical in outline and is both plain and painted, sometimes painted inside. There are fanciful creations representing animal or human figures, a bear, fish, frog, or the plumed eagle that is a familiar design in Mayan art. There are human effigies, and an owl water bottle whose brown and white painted feathers stood out distinctly until re-acquaintance with surface air faded the long buried colors. The tools for making the pottery are also here. A collection of pottery trowels and other implements lie at the head of a woman—she is Number 87—which suggests that Number 87 was an expert potter, perhaps the potter-in-chief of the community. And there is the man who was a leather worker, Number 60, with the tools of his trade about him—bone needles, punches, and an awl made from the heel of a deer.

Somewhat in the center of the group lies a person of importance, still in possession of the imposing earrings that so long ago dropped from their fleshly moorings. They are large wooden earrings covered with copper, circlets surrounding seven-pointed stars—again a suggestion of Mayan culture. The oxidation of the copper preserved the ornaments for our admiration. And between the feet of the august one is a human skull. Trophy, or slave? Or dutiful wife?

A family group is Numbers 1, 2, and 10—a man, woman, and infant. Number 76 lost all of her teeth, the only old person in the assemblage. Her age has been fixed at sixty, which was extreme age among the Mound Builders, whose years averaged thirty-five or forty. Number 38 is a woman accompanied by her six-year old child, Number 27. Numbers 8 and 9 are a couple, man and woman.

Burial ceremonials

The remarkable preservation of the bones is due to the fact that the burials were accompanied by a ceremonial of fire, and the charcoal so plentifully intermixed with the soil has prevented decay. The bodies were placed on the top of the ground and dirt heaped upon them. Often one was buried atop another—in some instances there are as many as five burials, one above the other.

Differences in the method of burial attract our interest. Besides the prone figures that suggest peace and hope—facing the sun, there are the bundle burials and evidence of cremation. The bundle or basket burial, as known to archæology, is the gathering of the bones of a body into a bundle after the flesh has disintegrated, then placing them in the burial mound. There is evidence of cremation in a small heap of charred bones resting in a crematory basin containing charcoal.

Leaving the Burial Mound, the visitor enters the temple building. Five feet below the top of the tallest mound a hard clay floor has come to light, outlined by a row of well-preserved post holes. Charred posts, that fit the post holes, lie on the floor; and over all are the charred remains of a thatched roof made of split cane bound with grass.

Beneath the fallen roof and its beams were found three rectangular sacrificial altars of burnt clay, and between two of them a charred post with braided rope attached, indicating that humans or animals for sacrifice may have been bound here. Earth was heaped upon the structure while this was burning, as is evident from the burnt condition of the soil above it, and its reduction to charcoal rather than to ashes.

Excavation beneath a portion of the temple floor revealed another temple building, five feet below the first. And here again are to be seen the hard clay floor, the baked post holes, and charred remains of a building.

One temple superimposed upon the other, both burnt in the same manner and covered with earth to the same depth, seems to tell the story of religious atonement. An angry god to be placated, or petitioned for surcease from famine, or drought, or plague.

We look next upon the civil affairs of the community. A third mound excavated to a depth of eight feet, revealed the remains of another structure which might have been a council house, or perhaps a chieftain's dwelling. It is rather spacious, the clay floor measuring twenty-one by twenty-five feet, as outlined by the post holes. Within the area there are other post molds, which may have held supports for benches, a platform, or the roof.

Prehistoric engineering

Outside the walls of the building there is a drainage ditch—a bit of prehistoric engineering. A space between the holes on the side must have been a doorway, and within there are three fireplaces. Near by is a heap of charred maize cobs, the remains of an ancient feast. Water jars and pottery vessels, nine of them, were found, that no doubt contained liquid accompaniment to the corn feast. A turkey caller of bone also was picked up, a useful article in the days when wild turkeys were abundant in the land. The kitchen midden of the region has produced a plentiful supply of the bones of deer, fowl, squirrel, raccoon, and land terrapin.

The discovery of the Ancient City on its imposing bluff was made by Mr. Fain W. King, of Paducah, who purchased the land and entered its exploration in 1932. Mr. King is a member of the board of regents of the Alabama Museum of Natural History, which institution has engaged in the excavation.

Fragile remains

Begun with picks, the work is continued with trowels; then orange sticks and camel's hair brushes are employed, so numerous and so minute are some of the objects; a thumb nail portrait sculptured in fluor spar; tiny shell ornaments, and frail bits of mica. It is the exceeding care with which this work is being done that is responsible for the wealth of treasure.

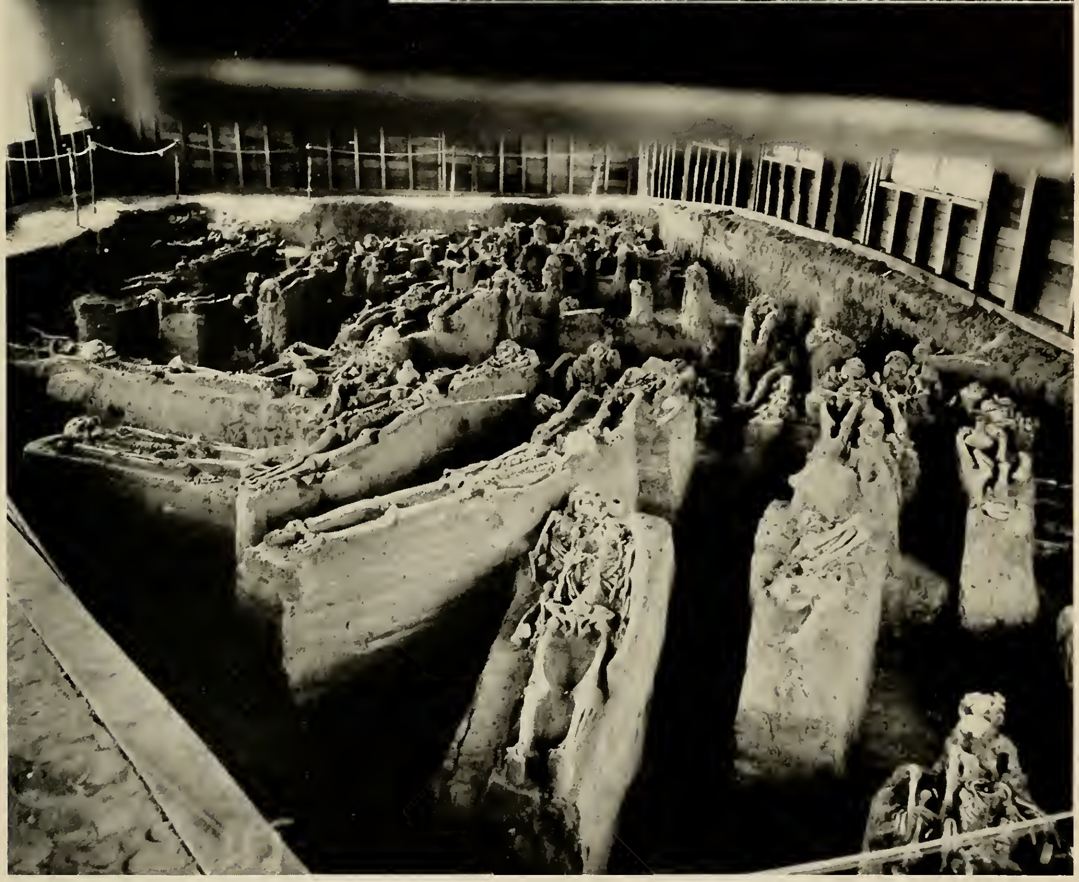
An additional attraction is the King collection of aboriginal relics of the surrounding region: an extensive array of objects, utilitarian, ceremonial, or of war, the observation of which enables the student to trace the relationship of the early peoples of the continent.

It has long been the established theory that North and South America were peopled by adventurers from Asia—the dispersal center of the human race—who crossed into North America by way of the Bering Strait, which at that time may have been a strip of land. Making their way down the Americas, these first inhabitants attained various degrees of culture in their different centers of habitation—the Toltec, Miztec, Cliff-dwellers, and the Mayan which was superior to all.

Science has done much to unveil the mysteries of the earth. Work such as is being done at the Ancient Buried City, in the fitting of innumerable facts into a great picture puzzle, enables us to look upon the history of humanity with increasing understanding.

Gazing down into the Ancient Buried City from the rim of the outside world, we see a stage in the unfolding of American civilization. We have had a glimpse of the panorama of the ages. And leaving the Buried City—by way of Wickliffe and U. S. Highway 60—we pass Future City and West Future City and again enter the Present.

A Mound . . .



Photo, courtesy of Murray State Teachers College

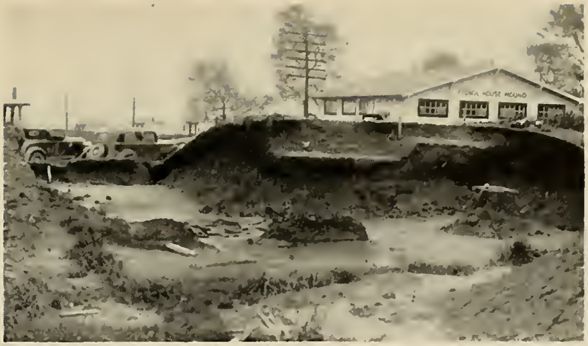
. . . and What Lay Beneath It

(Upper picture) The first excavation of the Temple Mound, one of the group of nine which constitutes the Ancient Buried City in Kentucky
(Lower) The Burial Mound, the excavation of which has revealed, to date, one hundred fifty-three burials, the remains of a people who vanished before America had been discovered by the civilized world

(Above) The tent which was placed over the Burial Mound during excavation work. It was later replaced by a permanent building

Uncovering

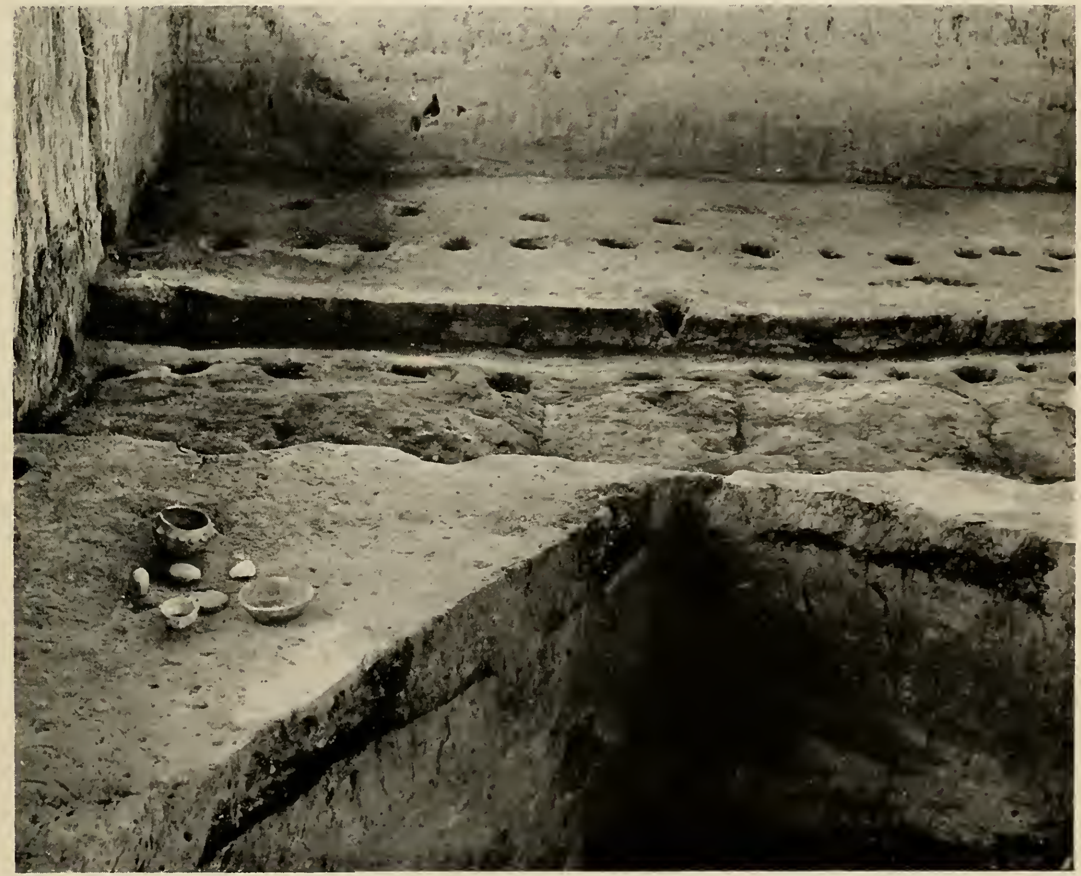
(Below) A portion of the charred temple building. The floor of this building came to light five feet below the top of the tallest mound

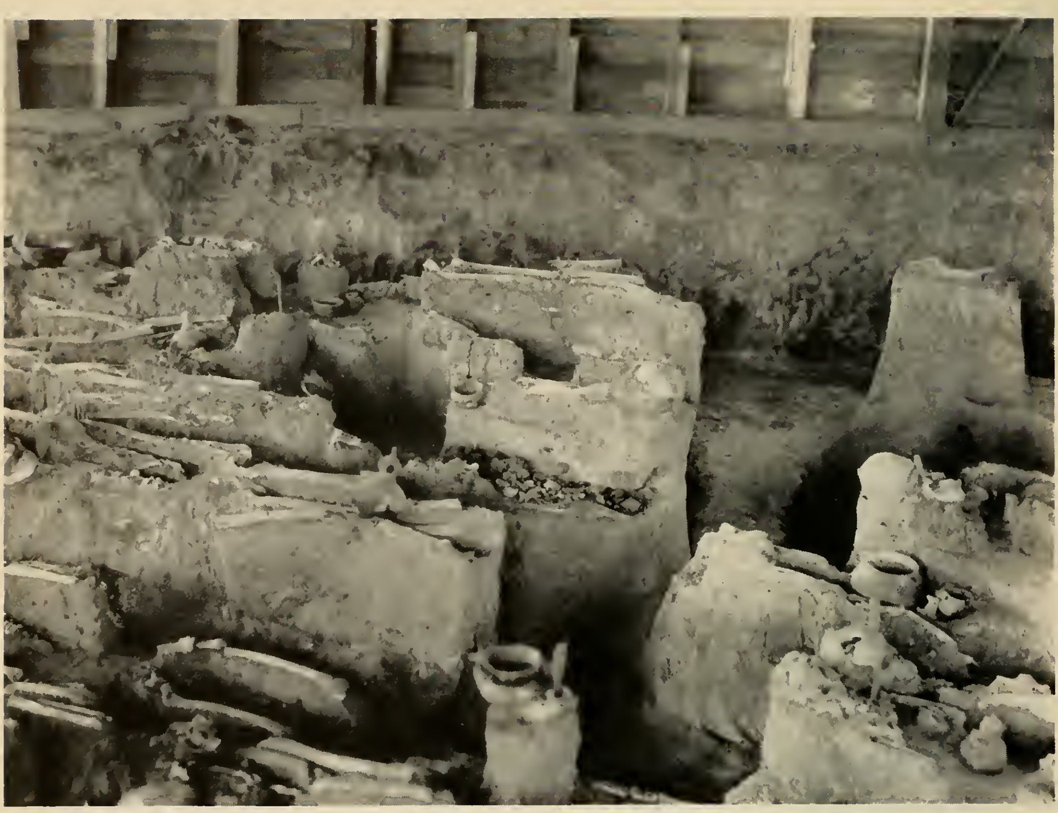


he Past

(Above) A mound in an early stage of excavation. This photograph shows the fourth mound; five more are as yet untombed

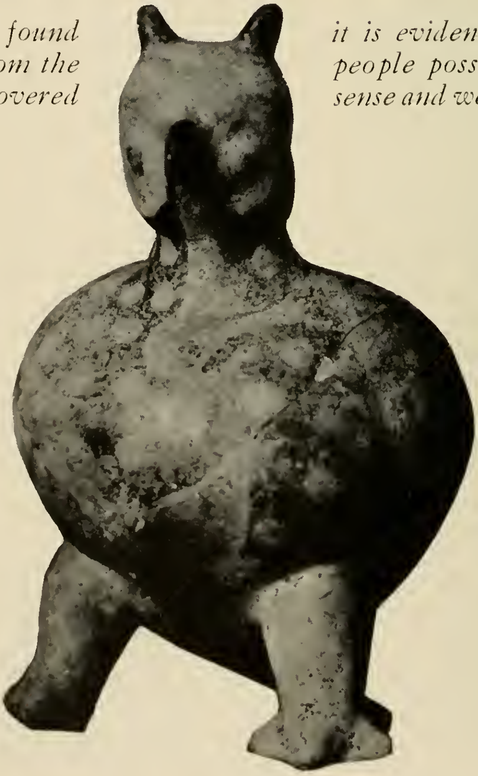
(Below) An altar in the Temple Mound. Three sacrificial altars of burnt clay were unearthed beneath the fallen temple roof and its beams





Photo, courtesy Murray State Teachers College

Pottery and other objects found in the Burial Mound. From the nature of the articles discovered it is evident that these ancient people possessed a keen artistic sense and were skillful workmen



(Right) A painted owl effigy water bottle excavated from the Buried City

Attacking Ocean Problems

Work on the multitude of unsolved questions concerning the sea and life within it, as carried on by the Woods Hole Oceanographic Institution

By George L. Clarke
Instructor in Biology, Harvard University, and Junior Biologist, Woods Hole Oceanographic Institution

In former times little was known about the sea. The causes of storms, tides, and currents were mysteries, and the activities of sea creatures often were sources of superstition. Today we like to think of these matters not so much as mysteries to be treated with caution but as problems which challenge our ingenuity.

It must be admitted that our understanding of even the basic questions about the ocean is still very poor indeed. The charting of ocean currents, the determination of the chemical and physical properties of sea water, the analysis of the mud at the bottom of the ocean and of the blanket of air on top of it, the growth, migration, feeding, and breeding of fish, lobsters, and whales—these and many more are problems which are being attacked at the present time.

An exacting science

The study of the ocean from all these points of view constitutes the science of oceanography and is fraught with such difficulties that it can be successfully pursued only with the aid of methods and equipment especially selected for the task. The investigators must be not only trained in several branches of science but also familiar with boats and the ways of the sea. An ocean-going ship suitably designed for the use of scientific instruments at sea is necessary, and specially constructed apparatus must be prepared. To meet all these requirements and to provide a center from which the oceanography of the western part of the North Atlantic Ocean could be conveniently studied, the Woods Hole Oceanographic Institution was established. This was made possible by a grant from the Rockefeller Foundation in 1930 which provided for a permanent and independent endowment.

Coöperating laboratories

The scientific staff of the Oceanographic Institution consists of the director, Prof. Henry B. Bigelow of Harvard University, and fourteen other investigators, most of whom hold university appointments as well. The Institution maintains its own laboratory at Woods Hole near the Marine Biological Laboratory and the United States Bureau of Fisheries Station. The three laboratories are entirely independent but their close proximity to one another makes coöperation feasible in many valuable ways.

The laboratory of the Oceanographic Institution is a well-equipped modern building. As we shall see, the real work of oceanographers is done at sea, but a shore laboratory is naturally necessary for the laying out of programs of investigation, for the construction and testing of special equipment, and for the analysis and study of the data and materials brought in from various parts of the ocean. In addition a considerable amount of experimental work can be done on shore, and various parts of the laboratory have been laid out to meet the requirements of special experiments in the physics, chemistry, and biology of sea water.

The location of the laboratory building on the harbor front at the water's edge makes access to the boats extremely easy. In the protected basin behind the Institution dock a fleet of small boats is moored, including the "Asterias"—a forty-foot power boat which is used for inshore work, particularly in the neighborhood of Woods Hole. Sufficient depth of water exists on the offshore side of the dock to permit the ocean-going research vessel "Atlantis" to tie up there between cruises, lying at a distance of only 150 ft. from the door of the laboratory.

The "Atlantis" was specially built for the Woods Hole Oceanographic Institution and was so designed that long trips to sea could be made and every type of oceanic investigation undertaken. A practically indefinite cruising radius has been obtained by making the "Atlantis" primarily a sailing vessel, although she possesses a serviceable Diesel engine for auxiliary use. This type of ship enjoys the other advantages of the greater stability provided by the sails—an important point when delicate instruments are being used—and the saving of space below decks, for a relatively small part of the 400-ton displacement of the "Atlantis" is taken up by fuel oil tanks. The vessel is 142 feet long, and although her hull, which is of steel, was designed for stability and commodiousness rather than for speed, her marconi sails will drive her as fast as ten knots in a good breeze. Her ketch rig is especially suitable for heaving-to at sea. She is manned by a crew of fifteen.

Floating laboratories

Six scientists may go to sea on the "Atlantis" and find comfortable living accommodations and plenty of space in which to work. The ship possesses two laboratories which are located one above the other amidships where the greatest stability is found. In the lower laboratory apparatus for chemical and for bacteriological work is securely screwed to the benches or stowed in specially constructed racks. The upper laboratory is equipped particularly for biological and hydrographical work. One may step directly from this laboratory out on to the deck, and it is from this point in the waist of the ship that most of the oceanographic apparatus is operated.

Heavy gear, such as dredges and trawls, is towed from a half-inch steel cable which is run from the end of a boom guyed at right angles to the ship's hull. There is enough of this cable to reach the bottom of the ocean anywhere and when not in use, its 30,000 feet are kept reeled on the drum of a huge winch in the bottom of the hold. Lighter instruments are lowered into the water on a more slender cable which is run out from a small deck winch. Both these winches, as well as much of the rest of the ship's gear, are run by electricity generated by the Diesel engine. The small winch is usually spoken of as the hydrographic winch because it is used to lower the hydrographer's principal instrument—the water bottle.

How ocean currents are studied

Since hydrography—or the study of ocean circulation—is basic to the other branches of oceanography, let us begin our discussion of the specific ocean problems which are being attacked by the Woods Hole Oceanographic Institution with a glimpse at ocean currents and how they are studied.

Interest in ocean currents was first aroused in connection with navigation. After years of experience and observation ship captains have become familiar with the more pronounced movements of water along routes of travel which tend to set them off their courses, so that today knowledge of this subject is sufficiently accurate to enable courses to be followed with satisfactory precision. For example, knowledge of the position of the Gulf Stream off the Florida coast enables skippers to take advantage of the current when sailing north by steering their ships into the middle of the stream, whereas when proceeding south they take pains to avoid the current by holding to a course close in shore.

Stay-at-homes, as well as mariners, may be profoundly—though indirectly—concerned with ocean currents because of the influence they have on climate. Thanks to the Gulf Stream, England enjoys temperatures characteristic of New Jersey, although it is in the latitude of Labrador.

But ocean circulation has a much more fundamental importance in the ocean itself in relation to the equalization of temperatures and the distribution of chemical materials and living organisms. The well-defined ocean currents such as the Gulf Stream and the Labrador Current are familiar to everyone, but these relatively swift movements of water are but a very small part of the whole picture. The water of the entire ocean is constantly moving (although the circulation in some regions is extremely slow) and this is fortunate, for were it not so, the sea would soon become stagnant and life could no longer exist in it. The sea is continually being heated in the tropics and cooled at the poles. Dissolved substances and sediment are washing into it from the land. Rain water is being added to it at the surface and putrefaction is taking place on the bottom. Everywhere living organisms are extracting substances from the sea water with which they build up their bodies and from which they derive energy for their life processes. Thus it is obvious that if the water in the ocean were not continually mixed, harmful temperatures would be established and poisonous products would accumulate in some regions while necessary nutrients would be exhausted in others.

Circulation of sea water

Mixing is accomplished in three ways, namely, horizontal circulation, vertical circulation, and turbulence. In the North Atlantic Ocean, for example, the horizontal movement consists of a huge eddy—of which the Gulf Stream is a part—which revolves in a clockwise direction. The primary causes of circulation in the sea are the differences in the density of different water masses and the driving force of the wind acting upon the surface. The density of the water can be calculated from its temperature and its salinity, or saltiness. Accordingly, the hydrographer's first problem is to measure the temperature and salinity of the water in the various parts of the ocean and at intervals from the surface to the bottom. This brings us back to the water bottle, mentioned above.

This instrument consists essentially of a tube which is attached to the deep-sea cable and lowered to any desired depth. A weight slid down the cable strikes a trigger on the tip of the instrument which causes valves at the two ends of the tube to close. A sample of water is thus sealed in the instrument and can be brought to the surface uncontaminated by the overlying strata through which it must be hauled. The water is then drawn off and its salinity and other properties may be measured immediately on board ship, or it may be bottled and taken back to the shore laboratory for more detailed analysis.

Special deep-sea thermometers are attached at the side of the water bottle. These are constructed in such a way that when the valves of the water bottle are closed, the mercury in the stem of the thermometer is cut off from the bulb and temperature changes encountered as the instrument is raised to the surface do not influence the reading. By placing a series of ten or more water bottles at intervals along the cable, the hydrographer may obtain a sample of water and a measure of the temperature at as many depths in one operation.

Problems involving the surface of contact between the water and the air above it fall to the lot of ocean-going meteorologists. It is extremely difficult to measure the driving force exerted by the wind on the water in the production of ocean currents, but an estimate can be made of the acceleration of the water by measuring the retardation of the air. This is done by studying the change in speed of pilot balloons from the moment they are released near the sea surface until they reach the upper air.

Sea evaporation

Another problem which meteorologists are attacking is the measurement of the rate of evaporation from various parts of the ocean. This is important because evaporation from the surface tends to increase the salinity and to decrease the temperature of the water left behind, and, as every schoolboy knows, the water taken into the air as vapor is transported long distances by winds until it is finally precipitated as rain or snow at some later time. At first the evaporation rate under various weather conditions and in different regions of the ocean was measured directly from pans on the deck of the ship. It has recently been found possible, however, to obtain the data much more simply from calculations using the relative humidity and wind velocity measured by suitable instruments placed at different heights above the sea surface.

Another set of problems in oceanography centers about the sea bottom. The "Atlantis" is equipped with a sonic sounding apparatus by means of which the depth of water beneath the ship's keel can be instantly ascertained. This remarkable instrument not only is an aid in navigating the ship, but also makes it possible to chart unexplored parts of the sea with rapidity and precision.

Deposits on the sea bottom

The nature of the ocean bottom itself and the rate and manner in which deposits are laid down are of particular concern to geologists. Devices constructed for obtaining samples of the bottom vary from huge dredges with sharp cutting teeth for breaking off rocks from the walls of submarine canyons to long tubes for obtaining vertical cores several feet in length from which the stratification of the mud can be studied. With the aid of another instrument a regulated amount of the bottom mud is scooped out and sealed up—thus preventing washing out on the way to the surface. From this sample a quantitative estimate of the various materials making up the bottom deposit can be made. The rate at which sediment is transported through the water or accumulates on the bottom is studied by measuring the material deposited in pans suspended for a certain number of days near the bottom or placed directly on the bottom. All this information is useful not only in interpreting the present situation on the sea bottom but also in understanding the formation ages ago of sedimentary rocks from ancient deposits.

Although the mixing produced by currents keeps the water fairly uniform in all parts of the ocean, variations in the physical and chemical properties of sea water do exist from place to place and from time to time, and these relatively slight changes have been shown to be of profound importance to the plants and animals living in the ocean. Of the physical factors temperature appears to be important for every type of organism, regulating its rate of development and limiting its distribution. The pioneer oceanographers were astonished to find that deep hauls of their nets in the Sargasso Sea brought up many kinds of organisms which were familiar to them as surface dwellers in Arctic waters. This situation is now understandable since we have discovered that the temperature near the bottom of the ocean in the tropics is just a few degrees above freezing and that this cold water mass is continuous with the northern surface water which is sinking and moving toward the south.

The green plants of the sea require light for their growth just as their terrestrial cousins do, and the measurement of submarine illumination is another item on our program of work at the present time. For this purpose photoelectric cells, mounted in water-light cases and provided with long insulated cables leading to delicate instruments in the ship's laboratory, are lowered into the water and readings are made at increasing depths until the light becomes too weak to be measured. Transparency varies greatly in different regions of the sea. In inshore waters, for example, the illumination at a depth of about twenty-five feet is reduced to 1 per cent of its value at the surface, whereas off our eastern seaboard an equal diminution of the radiation does not occur until a depth of one hundred feet is reached. And in the clear blue water of the Sargasso Sea, light penetrates to the extreme depth of five hundred feet before it is reduced to 1 per cent of its surface intensity. Plant life is limited to the "photic zone," and since the illumination may be too strong for growth as well as too weak, the vertical distribution of oceanic plants varies from place to place in accordance both with the transparency of the water and with the brightness of the sun. Below the photic zone perpetual night exists—except for occasional flashes of the weird phosphorescent light from deep-sea animals.

Chemical analysis of sea water

The sea water which is brought up in the hydrographer's water bottles is subjected to every conceivable treatment by the chemists. The chemical substances which are found in sea water are altogether too numerous and complex to be discussed here; suffice it to say that they are being intensively studied one by one. Information regarding the total salinity is useful to the hydrographer in helping him identify water masses and trace their origin, and it is important for the biologist in relation to the distribution and migration of fish and other organisms, particularly near the mouths of large rivers. Probably every known chemical element will some day be found to exist in sea water in minute amounts at least, and it is not necessarily the most abundant substances which are the most important. Particularly prominent from the biological point of view are the amounts of oxygen and carbon-dioxide present since these are essentially concerned in the life processes of all living organisms. The relatively small quantities of nitrates and phosphates in the sea are also especially significant since they are necessary for plant growth. These substances frequently become reduced or even exhausted at certain seasons in some regions with the result that the wheel of life is stopped until fresh supplies of the necessary nutrients are available.

Food for sea animals

The plant life of which we have been speaking consists chiefly of minute floating unicellular forms known collectively as the phytoplankton, for, taking the ocean as a whole, the familiar seaweeds of the tidal zone are relatively insignificant in amount. A survey of the diatom population (the most abundant and important element of the phytoplankton) can be made by centrifuging water taken at different depths in the water bottles and counting the organisms thus obtained under the microscope. The tiny plants form the ultimate source of food for all the animals in the sea, just as the more familiar terrestrial plants do for land creatures, because the green plant alone knows the knack of harnessing the sun's energy to synthesize the elemental food compounds from inorganic substances. Thus the phytoplankton serves directly or indirectly as nourishment for the smaller animals of the sea, some of which live on the bottom and are familiar to everyone who has visited the sea shore, while others, spoken of as the zooplankton and much greater in abundance though generally smaller, live drifting about in the water. Copepods—primitive crustaceans less than a quarter of an inch long—are probably the most numerous and most important members of the zooplankton considering the ocean as a whole. These small animals exist in such numbers off the coast of Norway, for example, that the commercially valuable Sei-whale feeds on them almost exclusively.

Bottom-living organisms are caught with dredges and trawls of various kinds, while plankton animals are procured by towing fine-meshed nets through the water. A rough quantitative estimate of the abundance of animal life in the water through which the net was drawn may be obtained by measuring with a current meter the actual amount of water which is strained by the net during the period of the tow. Sometimes the plankton net is lowered to the bottom and pulled straight to the surface, making what is known as a vertical haul. The catch in this case reveals the number of organisms present under an area of sea surface equal to the size of the mouth of the net.

It would not be safe to generalize too greatly from this single catch, however, because a second haul made immediately after the first would probably catch a distinctly different number of animals. In other words, the floating life in the sea is not dispersed uniformly throughout the water but seems to exist in irregular swarms. The reader will at once perceive that to obtain a census having any real quantitative significance of the abundance of plankton in a given part of the sea is one of the most baffling problems of oceanography. The effect of irregular distribution is somewhat mitigated by making long horizontal tows, but unless a great many of these are undertaken at different depths, there is always the possibility that the intervening unsampled strata differ widely from those in which the net has fished.

An ingenious device

Another complication arises from the fact that in attempting to study the lower water layers the catch will be contaminated by organisms taken while the net is being lowered to the desired depth and while it is being hauled to the surface again. To circumvent this difficulty it has been necessary to resort to specially constructed nets which could be kept closed except when they are towed at their correct depths. The mechanical difficulties to be overcome in building a device which will perform satisfactorily under the rough conditions experienced at sea and which will operate a net at a depth of say three thousand feet need no comment. Nevertheless, although our present closing nets are not ideal, much valuable information about the vertical distribution of plankton has already been obtained and our technique is continually being improved. At the present time we are able to operate simultaneously as many as five closing nets attached at intervals to the same cable.

One extraordinary fact about the plankton, revealed through the use of closing nets towed at different levels, is the occurrence of a vertical migration which takes place twice each day in many parts of the ocean and perhaps universally. It has been found that copepods and some other kinds of zooplankton swarm toward the surface at night but as soon as daylight reaches a certain intensity, these animals start swimming rapidly downward. With the waning of the illumination in the afternoon the animals move toward the surface again and the diurnal migration continues. Careful measurements of the intensity of the illumination at various depths at different times of day revealed the fact that the animals are forced to leave water strata in which the light has become stronger than a certain value and are thus caused to move progressively downward as the sun mounts the sky. Precisely what causes the animals to return to the surface again when darkness falls is as yet a mystery and there are other complications in their behavior which are still to be explained.

Interrelationships

The interrelations of the various plankton organisms constitute another problem in oceanography. From the seasonal changes in the population certain inferences can be drawn as to the dependence of one type upon another. The problem is being attacked in another way by culturing the organisms in the laboratory and studying their food requirements. While the animals are living in the laboratory where conditions can be carefully controlled, the effect of other environmental factors such as light and temperature on their growth and development can be tested. This work is just being begun.

All of these primitive types of organisms are of practical importance to man in relation to the commercial fisheries. In the first place the newly hatched young of both fish and shellfish are so small and weak that they are easy prey for larger animals. Furthermore, it has been shown that the larvæ of certain types of fish feed upon diatoms, then, as the fry grow larger, a shift is made to an animal diet. When adult, certain commercially important fish and whales live exclusively on plankton animals; others feed on the more familiar bottom fauna, but most of these latter are dependent upon the plankton for their subsistence at some stage of their development. Temperature, currents, and other physical and chemical factors in the environment, as well as the food supply, play prominent rôles in the control of growth, spawning, and migration of fish.

A pyramid in the sea

Thus we see that, broadly speaking, a pyramid exists in the sea, with the smaller organisms at the bottom and each type serving as a source of food for the type above. As these various forms die, their bodies are decomposed through the action of bacteria, and their chemical components appear again in solution in the water. These are taken up once more by the plants and thus the cycle is begun anew. The bacteriology of the sea is, accordingly, another essential branch of oceanography and one which—though of fundamental importance—is still in its infancy. But even the bacteria, hunted down in the sea water itself, in the mud on the ocean bottom, and in the bodies of both living and dead organisms, are now being forced to yield up their secrets.

This fundamental interdependence of the various organisms living in the sea is characteristic of the science of oceanography as a whole. Every branch of the subject touches upon every other branch at some point. Currents, temperature changes, evaporation, sedimentation, chemical reactions, distribution of plants and animals, and the physiological activities of these—all are related.

To attack successfully any of the problems roughly sketched in the foregoing pages, cooperation from other branches of oceanography is not only an advantage, but in many cases a necessity. Accordingly the founding of such a working unit as the Woods Hole Oceanographic Institution, possessing a staff of oceanographers who are specialists in the various component sciences and equipped with the necessary boats and instruments, provides a hopeful outlook for the solving of these important problems.

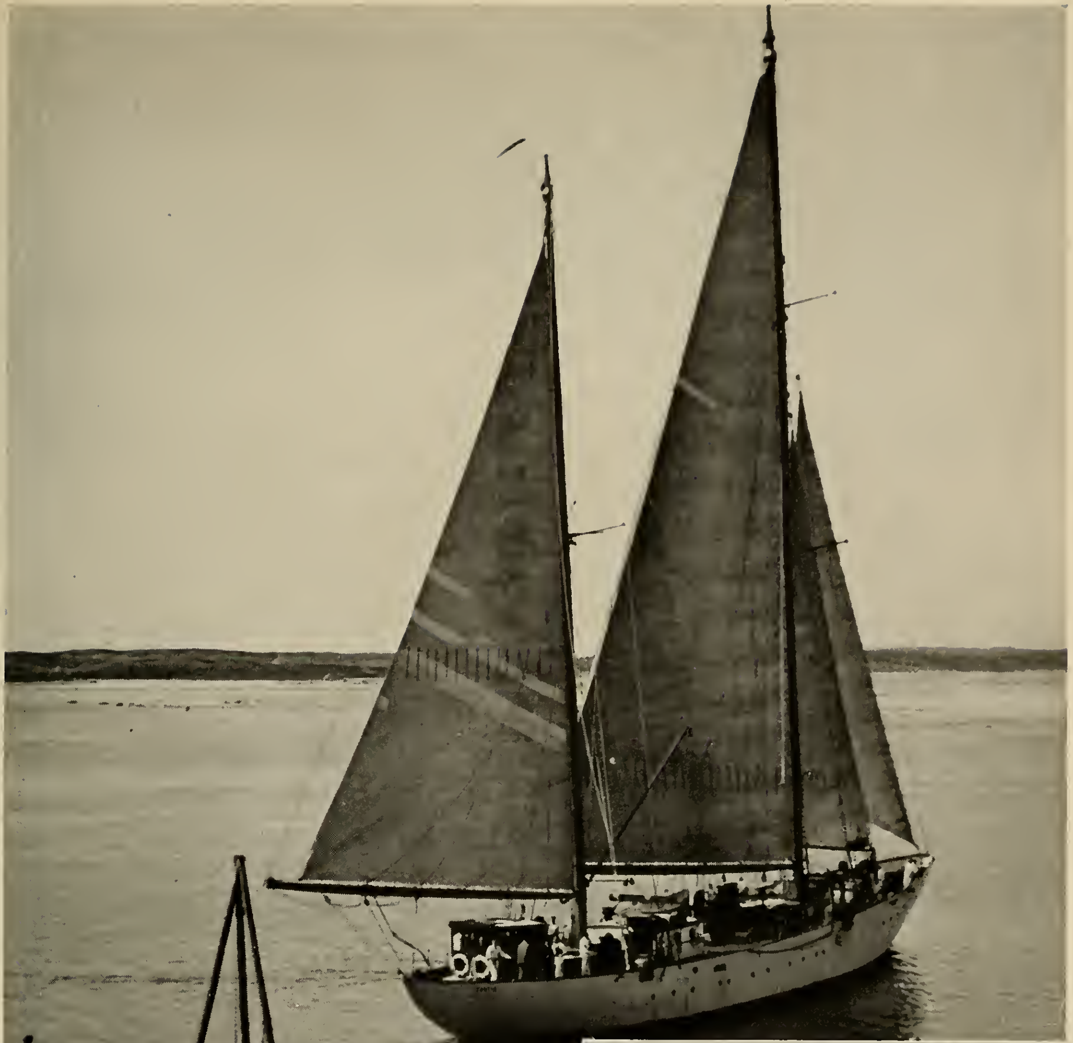


Photo by E. E. Watson

Photo by C. E. Renn

LABORATORIES ON LAND AND WATER

(Upper) The "Atlantis" leaving the dock under sail, a hazardous undertaking for such a large vessel

(Lower) The Woods Hole Oceanographic Institution. Behind the dock may be seen the protected basin for small boats

Rough weather is the bane of the oceanographer's existence, but strong winds are useful in getting from station to station. All but the most

WEATHER

Photograph by C. E. Renn

The bow of the "Atlantis" on a cruise in winter. The ship is in operation all year round, but observations in the north during cold weather are extremely difficult

Photograph by Marshall Schalk

ugged instruments would be smashed
o pieces if an attempt were made to
se them when the weather is whip-
ing up a sea like this

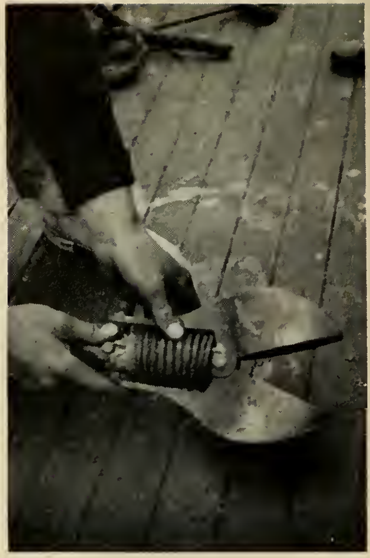
HAZARDS

Photo by C. E. Renn

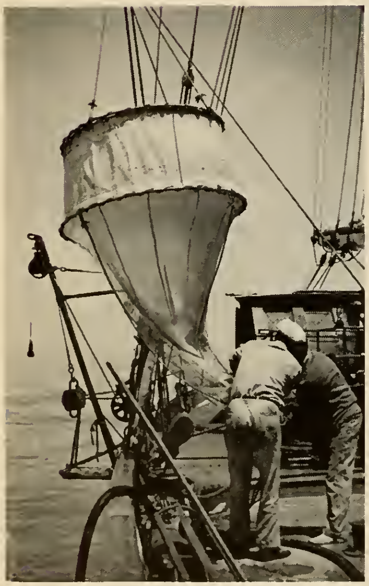
Snow and ice and numb fingers make hydrographic work precarious in mid-winter both for the men and for the valuable equipment aboard ship

ACTIVITIES ON BOARD

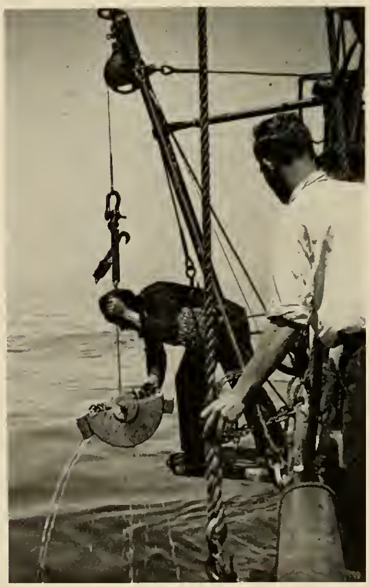
Studying the change in the velocity of the wind at different elevations above the sea by means of the pilot balloon. Photo by T. S. Greenwood



Snapper for obtaining small samples of the bottom. The jaws close automatically when the instrument strikes the bottom. Photo by C. E. Renn

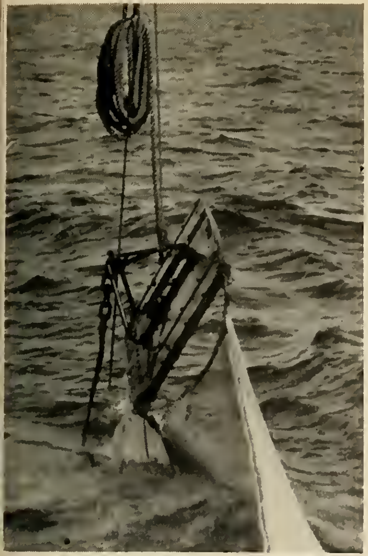


The plankton net is hoisted on board and the catch removed from the bottom end. The coarse net protects the finer net within. Photo by E. E. Watson

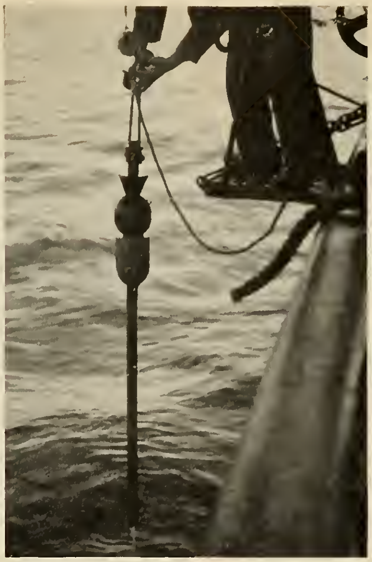


Petersen Grab bringing up a sample of the sea bottom, from which it is possible to interpret its present and often past formation. Photo by E. E. Watson

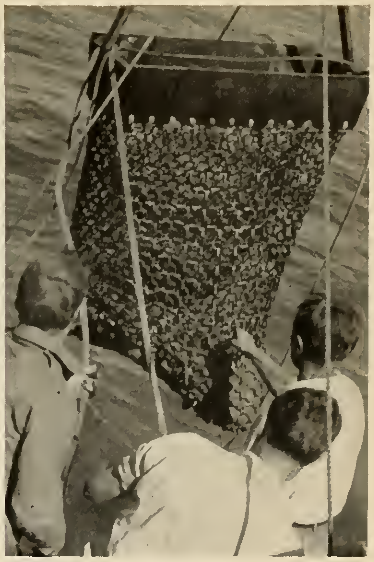
This man is following the movement of free floating buoys with a range finder, in the study of surface currents. Photo by E. E. Watson



One of the "otter boards" of a big fish trawl just coming out of the water. Various dredges and trawls are important aids. Photo by T. S. Greenwood



A weighted metal tube for procuring a vertical core of the bottom deposits, from which the stratification of the mud can be studied. Photo by C. E. Renn

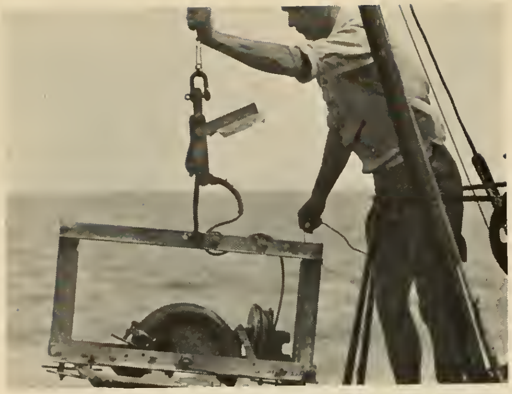


Dredge for obtaining samples of a rocky bottom or for breaking off chunks from the walls of submarine canyons. Photo by Marshall Schalk

Here the hydrographer's water bottle has been clamped to the cable and a "messenger" weight is being attached beneath it. Photo by C. E. Renn

Attaching a current meter to the cable before lowering it into the water for an investigation of the problem of ocean currents. Photo by C. E. Renn

Specific ocean problems are being successfully attacked by the Woods Hole Oceanographic Institution with the aid of methods and equipment especially selected for the task



A bottom sampler for quantitative work. The curved tube describes an arc through the mud and then its contents are automatically sealed up. Photo by T. S. Greenwood

The catch from the plankton nets is emptied into suitable containers where it may be studied and a record made of the organisms present. Photo by T. S. Greenwood

Passing one of the hydrographer's water bottles to the man on the platform. The water is then drawn off and analysed in the laboratories. Photo by T. S. Greenwood

The hydrographic winch in operation. As the cable passes over pulleys mounted on gallows at the rail, the amount of wire out is recorded on the dials. Photo by E. E. Watson

Chemical analysis being carried out in the lower latoratory of the "Atlantis." Plenty of light and head room has been provided below decks. Photo by T. S. Greenwood

Net for collecting Sargassum weed in a study of its distribution. This famed seaweed also harbors an abundance of fishes, crustaceans, and mollusks. Photo by T. S. Greenwood

Across Newfoundland

Fine scenery and fine people add zest to a search for pre-glacial fauna

By Stanley Truman Brooks

Curator of the Section of Recent Invertebrates, Carnegie Museum, Pittsburgh, Pennsylvania

Newfoundland, the New-Found-Land, is the oldest land, geologically, of the North American continent, the oldest of the British colonies, and the beginning of the British Empire. It was discovered only five years after Columbus discovered the New World, by John Cabot who in all probability was accompanied by his son Sebastian. What history could this grim northern island tell if it could but speak!

It is surprising that even in the nineteenth century no white man had crossed this island; no one knew what was "inside," or what treasures were there in store for the hardy adventurer. William Epps Cormack was the first to make this trip, and in the fall of 1822 set out from nearly the same spot where Balbo landed his fleet to make his way across the island on foot. His experiences were those of any pioneer; he lacked food and was chilled by the winds and snow. He suffered the same torments from the blood-sucking insects as one does today in that land. However, he found iron and coal, other minerals, and marble. His findings were the basis of many of the present industries of that still wild and untamed wilderness.

Interior is little known

Fundamentally a land of fisheries, the interior is still much less known than is the coast line. Today there are few maps of the 43,000 square miles of tundra, barrens, and forests. Information is scanty, and it was with some trepidation that I set out from St. John's to collect animals. However, after talking to many government employees and with fishermen and a few woodsmen I was able to lay out a fairly satisfactory itinerary for my journey, the purpose of which was to collect molluscs.

Pre-glacial creatures

Newfoundland received her fauna of land snails long before the appearance of the great ice cap that covered North America. While the waters of the northern Atlantic were warm and the inland seas of America were teeming with the scaly reptilian forms, the lowly land snails were migrating, forcing their way over the two great northern continents. Then, eons later, when the ice came out of the north and destroyed the fauna of our northern regions, a few isolated peaks on this new-found-land still stood above the snow and ice. The great ice sheet that covered North America did not force its way across the strait from Labrador; hence only a series of local glaciers covered most of Newfoundland. This condition enabled the surviving land fauna to live through this cold period and repopulate the verdant slopes upon the dispersal of the ice-sheet.

My task was to find these survivors and bring them back for study. In the laboratory these few thousands of specimens will help to piece out the story, I hope, of this early migration and cast further light upon the antecedents of the fauna of our own America.

Approaching St. John's by water, one is awed by the great cliffs that rise up from the sea like sentinels. No entrance can be seen in this seemingly continuous wall of stone until one is almost in the narrow entrance of St. John's harbor. The entrance is less than a quarter of a mile wide and at one time in the past was protected by a huge chain hung from cliff to cliff. Upon these rock walls towering some five hundred feet above the water are the ancient ramparts of both French and English forts. Now standing upon the crest of the northerly head is Cabot Tower. The first wireless message was flashed across the Atlantic from this stone building, and the eyes of many aviators have beheld this as the last of American soil to be seen as they faced the vast Atlantic and the vaster unknown.

Old world quaintness

St. John's is a city of nearly 50,000 inhabitants and is the metropolis of the island. Its cobblestone streets resound continually with the rattling and bumping of the two-wheeled carts that are so characteristic of its water front. These carts, drawn by the small Newfoundland horses, are interspersed here and there with motor cars. One expecting them to proceed on the right side of the street as in the United States will unwittingly step out from the curb at the wrong time, for they follow the opposite rule. It takes some time for one to reverse one's pedestrian habits.

The streets have an old world quaintness. Many of them are steep and are bordered by long flights of steps. The houses open on to the sidewalk and their somber fronts reflect the British respectability of their inhabitants. Walking along the streets, one is especially impressed by the youthfulness and high character of the police. Only recently reorganized, this force is expecting to become the "Mounties" of Newfoundland. They are in reality both the police and the standing army of this island. They are "sold" on their jobs. Like the English Bobby, they can answer your questions. This is also illuminating to the tourist.

This city is the cultural center of Newfoundland, and is full of historical interest. Old guns and the remains of French and English forts dot the cliffs near Cabot Tower. From that eminence one can look down on the city and harbor; the long, tortuous water front with its ships of all sizes and the "flakes" of the fishermen that live along the shore. The flakes are the drying racks upon which the catch is spread to dry. If one walks along the water front, one will meet many a stray zephyr wafted up from these industries.

With my plans completed and shopping done, the start to the interior was made. The Newfoundland Railway is a narrow gauge road that meanders for some five hundred miles before it ends at Port-Aux-Basque on the west coast. The first stop was made about seventy miles from St. John's, at Whitbourne. Here one gets the first fragrance of the early summer planting. Every plot of ground and every field either planted or to be planted in food stuffs reeks of decaying fish.

These fish, the caplin, come into the shoal water in great numbers about the first of June. The fishermen-farmers drive their two-wheeled carts to the beach. There, with a throw-net, they are soon filled and the scaly fertilizer is taken back to the fields and gardens. Every pasture and every garden glistens with their slender, silvery bodies. The odor becomes increasingly terrific day after day until one passes the last seaport on the trail to the interior.

The caplin is one of the most delicious food fishes produced in Newfoundland. Being a fish-lover, I groaned to see all of these fish wasted while I was being fed upon "bully beef" and canned rabbit. Later, upon insisting, I had two fine meals of caplin. But, according to my landlady, they never have more than one meal of them a year. A small quantity are pickled or dried for export.

Collecting in this region was disappointing, and after a few discouraging days I caught the bi-weekly train for the west.

Language difficulties

While in this region, and in my first contact with an "outport," I found several peculiar modes of speech. A seasoned Newfoundlander is able to tell the various outporters by their speech. This, of course, I could not do. But among those I had for guides and among the children of the village who followed me on my quests for snails and insects were many peculiarities. Snails that I collected were "wrinkles," dragon flies were "horse-stingers," mussels were "pussels," and any insect or animal not bearing a common name was a "machine." Imagine my surprise the first time one of my companions hallooed to me that he had a "machine" for me. There is an inbred courtesy among these people, and most questions directed toward me were prefaced by the usual "Sir?".

Half a night on the train brought me to Clarenville and its neighbor, Shoal Harbor. These two villages meander along the coast for several miles, losing themselves in either direction in the vast forests. The smooth waters of the bay are now famous, for it was there that Italo Balbo landed his fleet on its epoch-making flight to America. The villagers are still talking about that time, when the eyes of all the world were on this isolated water and the Italian battleships lay at anchor at their very doors; and many feminine hearts still beat faster when they think of the gallant ship's officers and sailors who for a time made their home there.

A disturbing discovery

The first day or so of my stay in this place was marked with cold rains and fogs, but finally these lifted and I set out into the woods with my guide, Leslie Tuck, a young school teacher. The day was not profitable but interesting. The wild iris blooming so profusely enticed butterflies and clear-winged moths. A little lake of brownish water yielded water beetles and dragon flies. After wading in this hilltop pond for most of the afternoon and returning to the hotel I learned that this prolific bit of water was the unpurified source of our drinking water. It was a light tea-color and, believe me, after that I watched very carefully for beetles or insect larvæ in my glass.

Through a faint memory which my guide had of "wrinkles" seen in the past and a trip of some eight miles through swamps and underbrush I was able to collect my first land snails of the kind valuable to me. One of these is a large species of the form common to Europe, also found in the eastern United States and Canada. It is called *Helix hortensis* and has been an article of food of the European from time immemorial.

Some theories as to how these snails got to Newfoundland are interesting. Some have said that a ship carrying straw, etc., was wrecked upon the shore and that these unsuspected stowaways survived and spread over the land. Another was that Leif Ericson brought them with him as food on his voyage of discovery. This species was perhaps the last immigrant to make its way across the Atlantic and populate the islands of the St. Lawrence embayment and our eastern states.

This first success was heartening. Other kinds found with this large species varied in size down to less than the width of a small pinhead. It is a thrill to go so far and then find these minute animals that we knew must exist there.

Mine was not the first journey of discovery to set out with Random Sound as a portal to the interior. Cormack on his trip across the island in 1822 began his advance into the unknown at this point. When he started, he and his guide were on foot, the interior was unknown and inhabited only by redskins. He knew not what he would meet or whether he would ever see the west coast. I also did not know what I would find, but the path was smoother. I rode a "trans-islandic express," he "shank's mare." He suffered from the same blood-sucking insects that I did. The forest, the bogs, the hills and mountains have not changed, and the average citizen of St. John's still looks upon the outports as the beginning of nowhere.

In the pulp wood center

My next stop to the west was a day's ride on the "express," and landed me in the valley of the Great Exploits River. This is the largest river in Newfoundland and is the center of the pulp wood industry of this island. Grand Falls is the third largest city in Newfoundland and is a mill town, being ruled by the large paper mill of the *London Daily Mail.* Grand Falls is a city unique in that it has known no depression. Newfoundland in general has been hard hit by the depression, but this city has continued its busy way. The trained "paper makers" are still paid high wages and a happier and more carefree group would be hard to find.

Here I found hospitality and coöperation, and a happier, busier, and more profitable week could hardly be imagined. Days were spent along the shores of the Exploits where for five miles up its turbulent surface fleets of logs were floating and tossing on their way to the mill. This constant flow of timber, all cut to the proper size, is regulated by the huge booms, or chains of logs, that stretch out across the more quiet parts of the river. Above some of these booms the water is solidly covered and appears as a river of wood.

Along the roads, in the streets of the city, and in all vacant areas, goats, the small Newfoundland horse, and the remnants of the strong Newfoundland dog run loose, hampered by no barriers but those erected by the people to preserve their gardens. It was not uncommon to see a dog team, not hitched to a sleigh, but to a small wagon, drawing large loads of kindling (splits) along the roads and streets.

Summer was now coming on in earnest; the dragon flies, butterflies, and other desirable insects were emerging in great numbers, and we were kept happy and busy in their pursuit. A day of collecting always meant an evening of work in preparing the material for packing. Everyone was helpful and hardly a day was spent alone in the field. Through the kindness of one of my new found friends, Albert Green, a paper maker, I was allowed the use of the company club, and there to my delight I found the first American newspapers and magazines, and sad to say, the last I was to see until my return. The first letters from America arrived during this busy week and added much to the occasion.

Up the social ladder

I must mention that my tour so far had been made in overalls and high leather boots. These were an open sesame to the people and they accepted me not as a foreigner but as a prospector. An amusing incident occurred in Grand Falls. When I arrived dressed in the field-soiled clothing, incidentally the poorest dressed man I had observed with the exception of some lumbermen returning from Labrador, and registered at the leading hotel, I was immediately put at one of the side tables. I found my companions at the table good fellows and thoroughly enjoyed them. Later, when my first mail arrived bearing the name and the seal of the Carnegie Museum, the landlady asked me to change to another table and escorted me to one set for four. I thought immediately that I had offended someone and that they had asked for my removal. Then I met the men at my new table as they arrived, the one the minister, and the other the banker. I was still in my overalls and blue shirt, but at this table I received orange juice for breakfast while at the other tables this was not served. In spite of the overalls, boots, and my ever-present odor of fly-dope which was indispensable, I was elevated to my proper (?) place in society. Naturally I enjoyed the orange juice.

On the day of my departure rain came down in torrents, tropical in amounts, but glacial in temperature. This rain seemed to spell the end of summer as from then on the weather was colder and collections were not as prolific although more valuable.

A native trait

Honesty is as characteristic and as widespread as one would imagine Roman noses to be in Rome, and a good example was my experience at Grand Falls. I left the taxi quite hurriedly at the Grand Falls Station and took shelter in the small station waiting room. I piled my eight or ten pieces of heavy baggage on the floor and threw my leather coat down with them. The waiting room was crowded with lumbermen, as the night before quite a group of striking and penniless workmen were ejected from the train at this station. Most of them were poorly dressed and in need of clothing. In the rush to get all of my baggage on the express, I dropped my leather coat, and I did not realize my loss when the train began to pull out. Looking out of the window I noticed a poorly dressed individual holding a leather coat. It looked very familiar and I began to rummage around. It was my coat!

I informed the conductor. He told me to get off of the train at the next stop and telegraph. Nearly an hour later this was done and I resigned myself to my loss, as a leather coat in Newfoundland is a handy and necessary article of apparel. If my coat was found it would be sent on to me at Corner Brook. At Corner Brook I was to take the steamer north to Bonne Bay. The boat left in three days and the next train from the east was also three days away.

To make the story short, I arranged for it to be placed on the boat at Curling if it missed the boat at Corner Brook, and sure enough it was waiting for me on the steamer "Sagona." My pipe and new wallet of tobacco were still in my pocket and untouched. All over Newfoundland one will find such honesty. During the entire two months I never slept behind locked doors and for that matter there were no keys to fit the doors; not even at my hotel in St. John's.

The few days in Corner Brook waiting for the upcoast boat, the "Sagona," were spent in shopping for a few necessities, taking photographs, and dodging the four hundred automobiles that this region boasts. There are about twenty miles of road for this number of vehicles so that the dust in the streets is never still.

A cross section of life

The "Sagona," a bi-monthly boat of the Newfoundland Railways Company, is one of the few connections that the people of the west coast of Newfoundland have with the outer world. Food stuffs, supplies for the fisheries and for the lumber camps are disgorged from her holds at each stop. Persons ill and in need of hospitalization await her arrival, visitors to and from the various ports crowd her decks. All in all, the life aboard the "Sagona" is a cross section of the life of the west coast.

On the cruise to Bonne Bay we left Corner Brook and Curling in the growing dusk. The beautiful Bay of Islands with the snow clad table-lands in the distance is like a vast enchanted lake with the greens and browns of the forested hills blending into the gray of the distant fogs. The plants and homes of Curling lose themselves in the distance, a mere line between the frowning hills and the placid water of the bay and river. The setting sun silvers the waters at the bow with a dazzling brilliance and then changes to the red and gold of twilight.

The purple shadows lengthen across the water, and as the hills and valleys of the fading landscape darken, we make our first brief stops. The peace of the tiny port is disturbed by the whining of the cargo hoist as the precious boxes and barrels are lowered to the dock. The whole village is in attendance; some recognize friends and soon the deck is crowded, greetings are exchanged and gossip of the fishing or logging conditions occupies the time until the short blast of the whistle sends them scurrying ashore. We are off to the next port and the performance is repeated.

All night long this occurs. In some places the harbor is too shallow and the boat cannot reach the dock. Then the cargo is lightered out to the ship along with the passengers for the north. The fishermen's faces in the dim light shed from the cargo deck are animated white splotches upon the inky blackness of the water, and as they are tossed up and down by the swell of the sea, they present an unreal, eerie picture. Only their skill born of the years on the sea prevents the heavy cases and barrels from going overboard as they are lowered from the swaying ship's boom.

Morning approaches and I am still pacing the deck. There is too much to see in such a short time, passengers to talk to, odors of the sea to be detected, to sleep away this precious bit of existence. The cabins are filled with the women and children. Most of them are able to sleep the night through. Others not so fortunate "bed down" on the upholstered seats around the combined dining room and lounge. Women with their children in the protection of their out-thrown arms sleep and toss with the roll of the boat. Here and there one awakens and repairs the damage to her coiffure, others awaken and do not seem to care. A restless baby arouses a toil-worn mother and she sleepily arises to nurse it or to search for the evaporated milk in the pantry. Several times I helped prepare the milk for the crying infant or obtained drinking water from the cask on deck for a seasick person.

The goal in sight

All of this was life to me. Men in homely postures, sleeping on the dining room tables spread-eagle upon their backs, their mouths open, the harsh schlup, schlup of their stertorous breathing mingled with the creak and crash of the tackle overhead. Morning awakens hazy, misty, with the ever-present fog wraithlike over the distant mainland. An entire night's journey, a dozen stops for cargo and passengers, and we are still within a hundred miles of our starting point. But, we are in Bonne Bay, among the mountains of the Long Range, the final goal of my journey.

On the peaks, barren and wind swept, lived the present fauna throughout the long glacial period. Here my animals were preserved by fate to tell us more of the history of that great era. Here I was to spend the last month of my trip and here I was to find the answer to some of my questions.

With a long blast of her whistle, the "Sagona" drew into the dock. I was introduced to my landlord by the lumber boss with whom I had traveled from Corner Brook. Mr. Tapper, as his name happened to be, took me under his wing and soon I was settled in the Staff House of the lumber company. Later I was to present my credentials to the superintendent of the company and ask his permission to remain in this village, which like others is controlled by the lumber company. It consists of the homes of the workmen, a company store, and a combination telegraph-post-office.

An impressive wilderness

Life in Lomond was ideal; interesting companions, excellent cooks, plenty to eat, and all day for work or play. Naturally I was here to collect and not to play, but for that matter, collecting is so pleasurable that it may sometimes be play. However, the insects would not let you get too rosy a feeling about life. In the mornings, even though wet, foggy, and chilly, the tiny punkies or biting midges were out in great numbers and the burning sensation that they produced seemed to engulf the entire body. They are small but cause a large amount of misery! The woodsmen at this time of day suffer greatly. With the exception of two men, one the Swedish woods' boss, Mr. Johnson, and the other an Indian, every one was bitten by these pests. Later in the day, this species lets up its torture and gives way to the black flies, mosquitoes, deer flies, and a large species of horsefly or "stout" as the inhabitants call them. One may wear a head-net, but it is a nuisance in the brush and is early cast aside. The only other protection is "fly-dope." This usually consists of oil, tar, and citronella or other ingredients repulsive to insects. This dark and oily mixture is applied to every exposed surface. Perhaps this sounds forbidding, but after one has gathered a goodly crop of bites it becomes highly desirable.

From my bedroom window I could look for miles across the bay where a waterfall, springing from a snow-bound ledge, spent itself in a deep valley between the mountains. It must have been some distance away, but on quiet nights one could hear its rumbling torrent like the pulse of that wild country as it swelled and died away on the breeze. From all that I have said, the land does not sound very wild and untamed. I have only spoken of the area spanning the trans-islandic railroad and the coast line. The part that you can see in the distance, between the towering hills, is almost impossible to reach in the summer, completely uninhabited but for bear, moose, caribou, and penetrated only in the winter when one can make one's way *over* the underbrush on the deep snow. Strange as it seems, the interior is more accessible during the winter months. The inhabitants also look forward to this time when on snowshoes and with dog team they make their way into the hills in quest of game.

All my daily excursions out of this place were either on foot, by boat along the shore, or in the company truck that made the trip to the logging depot on the "inside" daily. By boat we cruised past great heads and vertical cliffs, long, sloping forested hillsides, and through quiet coves and miniature harbors. Some of the spots were jewel-like with their softly tinted flowers and shrubs, like some forgotten English garden. Other landing places were rough and strewn with boulders; each, however, yielded specimens to my ever rapacious knapsack. Every valley we passed echoed with the thunder of waterfalls and leaping streams.

The tallest peak ascended

During the month, one excursion led me to one of the tallest peaks in Newfoundland, Gros Morne. This is one of the glacial islands, which, as I have mentioned before, was the supposed place of survival of the local flora and fauna. It was my hope that upon its lower wooded levels specimens of plants and animals would be found that would aid me in my researches. This hope was gratified to some extent, but the trip was less productive of material than I had expected.

Arising early, I boarded the motor boat that I had hired for the day, and landed about eleven o'clock in a shallow bay. It was about a mile to the house of the guide, a Micmac Indian by the name of Lawrence Mitchell. Obtaining his services and after "boiling up," as the Newfoundlander calls tea making, we set out along the beach. The Indian said, "Here is the trail." But my inexperienced eye saw little difference between the trail and the surrounding thicket. It is as Cormack has aptly said, "The Indian idea of a road is to Europeans little more than the possibility of reaching a distant place alive."

Nearly three hours of labor through the thick underbrush brought us high up on the side of the mountain and out of the forests that cover its sides. Another hour of scrambling over the huge rocks and sliding talus finally brought us to the top and there we rested.

A panorama

Off to the left of us lay the faint coast line nearly hidden in the haze and fog; the land between the mountain and the sea was dotted with marshes and lakes. Back of us the other mountains flattened out into mere hills and the springs gushing from the rocky sides more than a thousand feet below formed lakes that appeared like so many silvery pools. Directly below us two thousand feet down a precipitous wall of rock and clinging shrubs lay a cobalt-blue lake. Across from us was a table-land flanking the lake, its sides rising hundreds of feet in the air and streaked with mud slides and long gray slides of rubble and stone. To the north, the mountains, like waves of the sea in endless march, stretched out in serried rows until lost in the haze of the distance.

This range, the Long Range, continues along the northern peninsula to its tip. There at the Strait of Belle Isle it faces the precipitous Labrador shore. A land of mystery with a spell of enchantment; what is beyond the next peak and what is beyond that?

My Micmac guide had traversed this entire range on foot and knew it all. He was not bothered by the flies, and the wilderness was his home. No matter what the labor of the day consists of he is ready to turn to the solitude of the forest and may spend days within it only to reappear later and take up his work where he left off. This was illustrated when first my companion and I met him. He had not known we were coming nor had he planned on making a trip that day. But when my boatman introduced me and told him that I wished to go up Gros Morne, he paused in his work (he was building a new house for the winter), and answered that he would be glad to go as soon as he drove in the nail he had in his hand.

While we were sitting on top of the mountain and later when we were gathered around his camp fire as we "boiled the pot," he spoke of his people, the Micmac tribe which came from Cape Breton Island and are of the Algonquin race, and of the aboriginal race, the Red Indians or Beothucks. He told me how one of his ancestors claimed the doubtful honor of having slain the last Beothuck. The story he told was as follows:

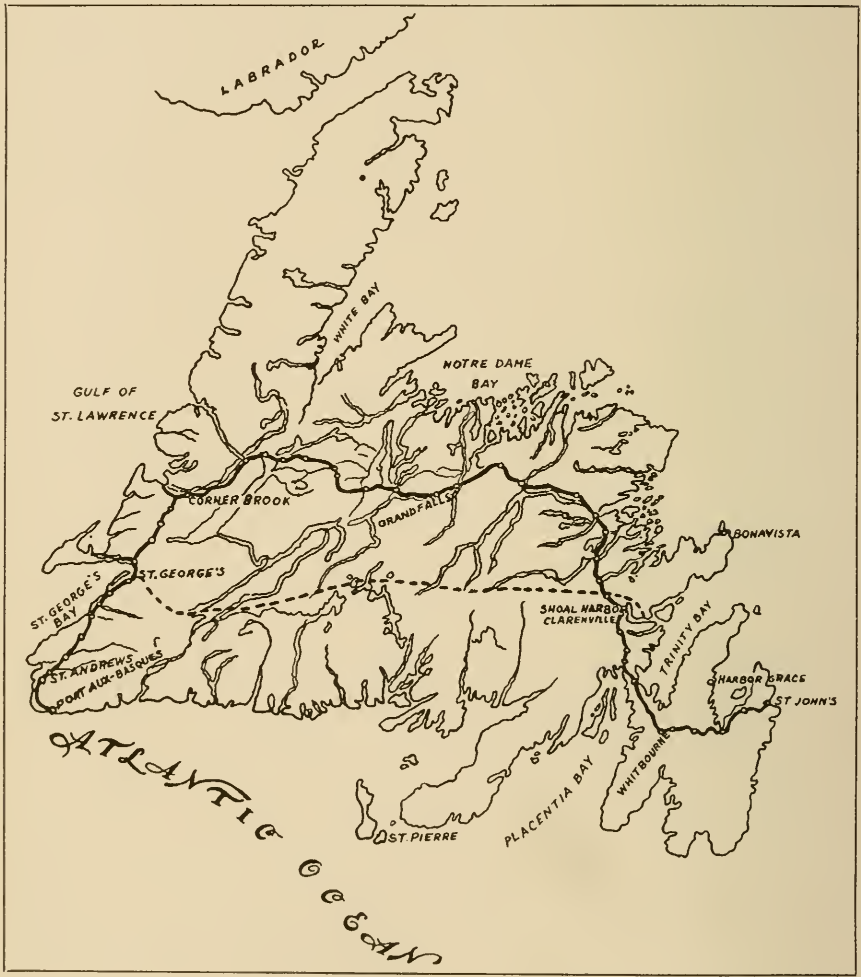
His ancestor and a friend had had bad hunting and during the long cold winter, as a last resort, had been forced to seek aid of the Beothucks who were camped near by. The friend was chosen and went to the Red Indian encampment to make his request. They invited him into their dwelling, they bade him sit and placed food before him. But as he squatted there on the floor and before he had time to eat, a powerful brave behind him drove his crude spear into his back; striking him in the neck and pinning his body, still upright and seated, to the earthen floor of the tepee. The Beothucks fled and Mitchell's ancestor, after waiting for his friend's return, came in search of him. He found him seated before the untasted food and swore he would kill every Red Indian in Newfoundland. He lived to his oath and killed many of them; the last one being shot from a tree where he had taken refuge.

The history of the Beothucks is a sad one and illustrates the crude human passion of cruelty. They were a fine race; tall, handsome, and of great intelligence. Their origin is shrouded in mystery. Some feel that they are of the earlier Algonquin stock that came to Newfoundland before the other groups. In the various books at my disposal I have found that there is a strong belief that the Red Indian is a product of the inter-mixture of the aboriginal Indian and the Norse immigrants that made their way to Newfoundland (Vinland or Markland of the Saga?), under the leadership of Leif Ericson. Several of their customs seem to point to this relationship: they made boats different from those of the mainland, they made puddings of suet that were contained in gut-casings, their wigwams were covered with skins and not of bark like those of the Micmacs, their hair was lighter, like that of the European, and their skin was more fair than that of the neighboring tribes. The name Red Indian came from the observation of their use of red ochre: their bodies, implements, boats, and habitations all were smeared with this pigment.

The presence of this group was observed by John Cabot at the time of his discovery of the island. The English lived fairly happily with the Beothucks, but when the French began their settlements, the thieving habits of the natives brought down their ire upon them. The French, becoming exasperated, placed a bounty on the head of every Beothuck. The Micmacs hunted them as they would so many animals; and in 1830 the last known survivor (according to historical notes) of this race died in the hospital at St. John's. So passed a race whose origin and history died with them, and in their place remain but a few remnants of their conquerors.

* * *

After all of the interesting days of my trip across Newfoundland and the entrancing beauty of Bonne Bay in its various moods, the day finally came when it was necessary to depart. I had learned to love the Newfoundlanders, their helpful friendliness and generosity. In passing I wish to pay them this tribute. Through all of the vicissitudes of climate, war, and the economic and political strife of these last years, the Newfoundlander has held his head high, full of hope and happiness, and has met his conditions with the minimum of despair. The hardy blood that conquered the icy northern seas and fed the nations of the world still speaks, demands life, liberty, and offers for them the sweat of his brow, the loyalty of his flesh, and his dreams of a future security and peace.


LABRADOR
WHITE BAY
NOTRE DAME BAY
GULF OF ST. LAWRENCE
CORNER BROOK
GRANDFALLS
BONAVISTA
ST. GEORGE'S
ST. GEORGE'S BAY
SHOAL HARBOR
CLARENVILLE
TRINITY BAY
ST. ANDREWS
PORT AUX-BASQUES
HARBOR GRACE
ST JOHN'S
WHITBOURNE
PLACENTIA BAY
ST. PIERRE
ATLANTIC OCEAN

NEWFOUNDLAND—BRITAIN'S OLDEST COLONY

The broken line indicates the route of the first crossing of Newfoundland in 1822, while the solid line follows the trans-islandic railway trip described in the above article

Photo from Ewing Galloway

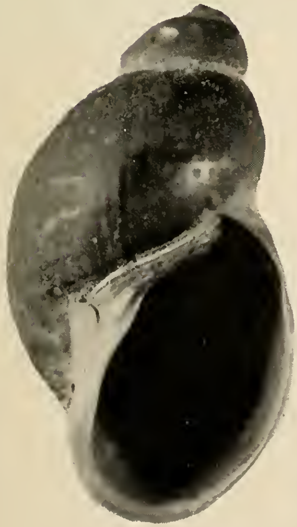
St. John's bottle-shaped harbor, showing the Narrows, a perfect gateway to the open sea. The entrance to the chief city of Newfoundland is less than a quarter of a mile wide

(Above) Exploits River, near Grand Falls. Much of Newfoundland is rocky

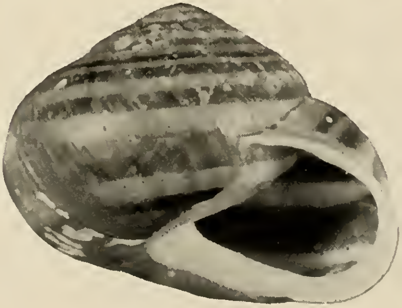
(Left) A type of snail found by the author near the above scene

(Right) Found near Whitbourne. Photographs about twice actual size

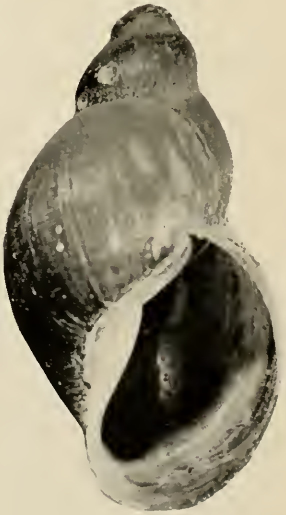
(Below) One of the latest arrivals to our shores during the pre-glacial period



(*Stagnicola palustris perpalustris*)



(*Helix hortensis* Müll)



(*Stagnicola palustris papyraceo*)

The beach of St. Pierre. This is one of two small islands south of Newfoundland where French is the language spoken

Exit of Quidi Vidi Inlet with the ocean beyond. Fishermen's dwellings, landing stages, and flakes for drying fish are at the right

(Below) Dried cod being loaded into boats at Quidi Vidi to be taken to market. Photograph by Philip D. Gendreau

(Above) Quidi Vidi fishing village, typical of the peaceful hamlets which nestle along Newfoundland's stern shores. Photograph by Philip D. Gendreau

Coves like this on Newfoundland's indented coast present welcome shelter from the boisterous North Atlantic. Philip D. Gendreau photograph

(Right) This old ship's figurehead in a St. Pierre street reminds the passer-by that many generations of seafaring tradition lie back of these islands

Photo by Ewing Galloway

(Above) A scene at one of the Newfoundland fisheries showing the cod fish spread out to dry. About three fourths of the annual harvest of fishes of our North Atlantic coast reaches the markets in fresh condition. The remainder reaches the consumer as canned, smoked, and salted fish

© Capt. Bartlett
From Gendreau

(Right) Gathering up the dried fish. A typical native in his workaday clothes. Notice his waterproof sealskin boots of Eskimo manufacture

From Ewing Galloway

Torbay, a little fishing village nine miles from St. John's. As usual, many fences cut up the landscape into a complex patchwork. The coastline of Newfoundland is exceedingly irregular and is indented by many deep bays and harbors

Photo from
Philip D. Gendreau

The fish are hauled from the shore to the flakes in two-wheeled carts like this one, drawn by the small Newfoundland horse. The horse will back the cart right out into the water to the boat's side

(Right) Looking from the summit of Gros Morne, the highest mountain in Newfoundland. This peak and a few other isolated ones on the island remained exposed during the Ice Age

(Left) Big Pond, near Lomond, Bonne Bay, where the author made his base for a month of field work

(Right) Salmon fishing near Lomond, Bonne Bay. Newfoundland's streams abound in various kinds of fish and many sportsmen travel there every year

A Strange Partnership

How Mayimba, a bird, and Kambole, a honey badger, combine their efforts to mutual advantage

By DON H. SELCHOW

FIGHTING my way through heavy underbrush for several miles one day in Northern Rhodesia, I unexpectedly came upon a small open space which was not more than ten yards across. Ordinarily I should not have noticed it as anything but a tiny natural clearing, but I happened to look down at the ground and saw that it was all torn up. The earth was almost powdered in spots and the grass and small vines had been torn up by their roots.

My rifle boy came up alongside of me from his usual station at my heels, took a look around and said "Kambole."

Other natives of my retinue drew up and talked among themselves; and from these conversations I gathered, strange as it may seem, that Kambole had been drinking.

"Who was this Kambole?" I began wondering, "and what had he been drinking?"

More discussion among my boys, a search around the ground, and a coarse black hair was tenderly picked up and brought for my inspection.

Another native called from one side of the diminutive clearing and we went over. I was shown a knot hole going deep into the trunk of a tree. In this hole were a few tablespoons of dirty looking liquid. My natives bade me to take a smell of this hole, which I did. One whiff was sufficient to tell me that alcoholic fermentation had been taking place therein.

This was my first introduction to the strange proceedings of Kambole whom I later found was known in English as the honey badger. Kambole is his Kaonde name and since it was by this name I knew him during my three years in Northern Rhodesia, I shall call him that in this account.

Characteristics of a honey badger

There are several things which immediately characterize Kambole. The first of these is the fact that he is one of the few animals which are completely black on the underparts and white on top. His hair is coarse and shaggy and in the warm weather it is rather thinly distributed. His total length is a little in excess of three feet, but he appears longer because of the shortness of his legs. Any zoölogical garden which has tried to keep a honey badger in confinement will have wild tales to tell about him, unless perhaps they had been warned of his tendencies ahead of time. He will smash his way out of a cage that appears to be strong enough for a much larger animal. His wanting to get out does not seem to be due to a terror of confinement but rather merely to a curiosity to go and sniff around the other side of the room. Kambole makes a very fine pet, providing you can keep him from straying away. He is very friendly and quite original in his antics, according to those who have raised one. His diet consists of small prey, insects, and, quite naturally as the name implies, honey.

As I have said before, the honey badger has short legs, which are better adapted for digging than they are for walking. Consequently, he is not able conveniently to make the long excursions necessary for finding sufficient honey to satisfy his appetite. To overcome this, as my natives presently maintained, Kambole has a partner in his enterprises: his friend Mayimba helps him.

Mayimba can cover mile upon mile each day and find every honey tree in the vicinity—for Mayimba is a bird. If he should whir over your head and you should look up and see him, his appearance would not demand a second glance. Slightly larger than our American sparrow, he is built along much the same lines, and is of a brownish-gray color. Yet he is an extremely clever bird.

As to how his amazing partnership with Kambole came about, the natives would not say; but they blandly told that the bird finds the honey, then hunts around until he finds a honey badger, and proceeds to lead the latter to the tree. Mayimba is a real opportunist, however, for if he can't locate a honey badger to open his honey tree for him, he will try other types of wild life and will even appeal to humans.

Among the BaKaonde the honey guide figures in their story of Creation, consequently they consider him above the ordinary birds. A spirit of fairness might not prompt them to leave a share of the young bees and honey for Mayimba when he has led them to a colony of wild bees, but their superstition demands that he be thus rewarded.

A dependable guide

The natives have learned that it is always well worth while to follow Mayimba. When the latter comes around chattering, they know that he has found a tree, and they shoulder their axes and whistle to the bird and off they go. Whenever they lose Mayimba they whistle again, and back he comes to show them the way. This is repeated until the goal is reached.

A similar procedure occurs, we are told by the natives, when Mayimba has located Kambole, though we cannot say with certainty that a white man has ever witnessed it. He swoops quite close to the badger and chatters as loud as he is able. "Chatters" best describes the noise he makes, for while it comes from a bird's throat it sounds more like the chatter of a squirrel. When Mayimba has caught Kambole's attention, he flies in the direction in which the honey is located, as if to say "Come on, it's over this way, hurry, I am hungry and you would be, too, if you knew how nice that particular honey is." He continues to dart at and over Kambole until the latter either goes or obstinately refuses to move. Whether the latter ever happens I do not know, but taking into consideration the honey badger's penchant for honey, I am inclined to believe he always listens to his bird friend. Once Kambole has started to follow Mayimba, the latter keeps leading him, chattering encouragement all the while, for Mayimba is a real salesman.

It may take several minutes, or perhaps even hours, for this couple to arrive at their goal. It is here that Kambole's real work begins. Of course if he has to come a long way he is probably fatigued, but there is no rest until the job of extricating the prize is completed.

Well protected hide-aways

The honey is usually located in a hollow tree trunk which has a very small aperture—perhaps about the size of one's little finger—where the bees go in and out. Sometimes the holes are so small that one way traffic seems necessary. The bees like to make themselves as secure as possible; and it seems the smaller the doorway to their dwelling, the better they like it. This entrance may be quite high in the tree but as a general thing it is about halfway up, because it is at that point that a tree is most likely to have a crack or small knot hole to serve as an entrance. The fact that the hole is up in a tree doesn't worry Kambole one little bit, for with his sharp claws he can climb right up.

Now comes a period of extremely vicious clawing and scratching in order to enlarge the hole enough so that the honey may be removed. The time necessary to accomplish this naturally depends on the thickness of the wood of the tree, but thick or thin, Kambole has strong claws with plenty of power behind them. It is for this reason that zoos have trouble in making a cage which will hold this innocent-looking creature. Cages which appear to be strong enough to hold animals twice the size of Kambole are just good fun to him.

Sometimes Kambole has it easy, for the natives make hives for the bees, hoping to have a private supply of honey, and these hives are very easy for Kambole to open. While the natives' diet is essentially farinaceous, consisting of meal made from corn or maize, their favorite delicacies are meat and honey. The latter is the only form of sweet they have and besides it can be used to make honey beer.

The natives make beehives from the bark

of trees. In order to do this, they make two complete cuts about three or four feet apart around the tree which is going to supply the bark for the beehive, and then they make a single cut parallel to the length of the tree. The bark is now pried off in one piece. This usually gives them a cylinder three or four feet long with a diameter of approximately ten inches, depending on the size of the tree used. Bark rope is used to tie the cylinder together again; circular pieces of bark are then cut to fit over the ends of the cylinder, and these also are tied in place. A small hole is cut in one end to allow the bees to go in and out. This hive is placed in the branches of a tree and tied to prevent the wind from blowing it down.

Attempts are made to prevent Kambole from raiding these hives. But usually our ingenious little friend will find a way of getting up to the hive, and when he does, it is rather unfortunate for the native owner, for Kambole will tear it open. The commonest method of preventing his attacks is to make a sort of platform around the tree so that in order to pass this Kambole would have to walk upside down on the underside of the platform before he could climb to the hive. Another method is to try to place the hive so high in the branches that Kambole can't get up that far, but it is rather difficult for a man to place something where such a tenacious little animal as Kambole cannot reach it.

A successful raid

Whether the honey comes from a native-made hive or from a hollow tree makes little difference to Kambole and Mayimba, it is still honey to them. Kambole is the first to taste the reward of their combined efforts. The bees are of course furious while their citadel is being attacked and opened up, but Mayimba keeps out of the way and Kambole has his coarse hair and a tough skin as a protection against stings, so the bees just buzz around him to no avail.

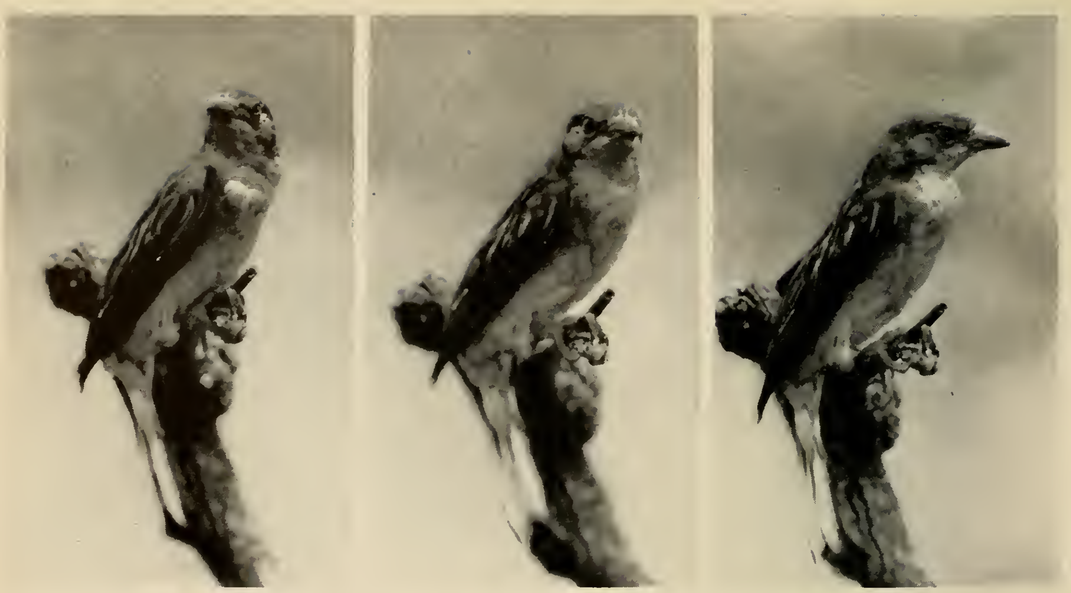
If Mr. Kambole, as the natives sometimes refer to him, had sleeves, one could just imagine him rolling them up after he had made the hole large enough to get at some of the honey. He will probably have quite an appetite by that time and will go right at it. Mayimba all this while will be chattering in one of the neighboring trees, making a tremendous racket. Finally, Kambole begins to feel a bit sluggish and descends the tree for a little rest. Now just watch Mayimba! Such fluttering back and forth you have never seen; his beak is too full, though, to make much noise. The part of the hive he likes best is that containing the young bees, which are encased in the wax combs. They are white, quite fat, and juicy.

Provident Kambole

African bees are very productive and there usually is more honey stored in the tree than the combined efforts of Kambole and Mayimba could begin to dispose of even over a period of several days. Kambole, however, is more frugal than his feathered partner, and after he has recovered from his first stupor, he sniffs around until he finds a stump of a tree with a hole in it. This, it is said, he scratches out, then goes back to the honey tree, takes a piece of the comb with the honey in it, carries it to the stump, and puts it in the hole.

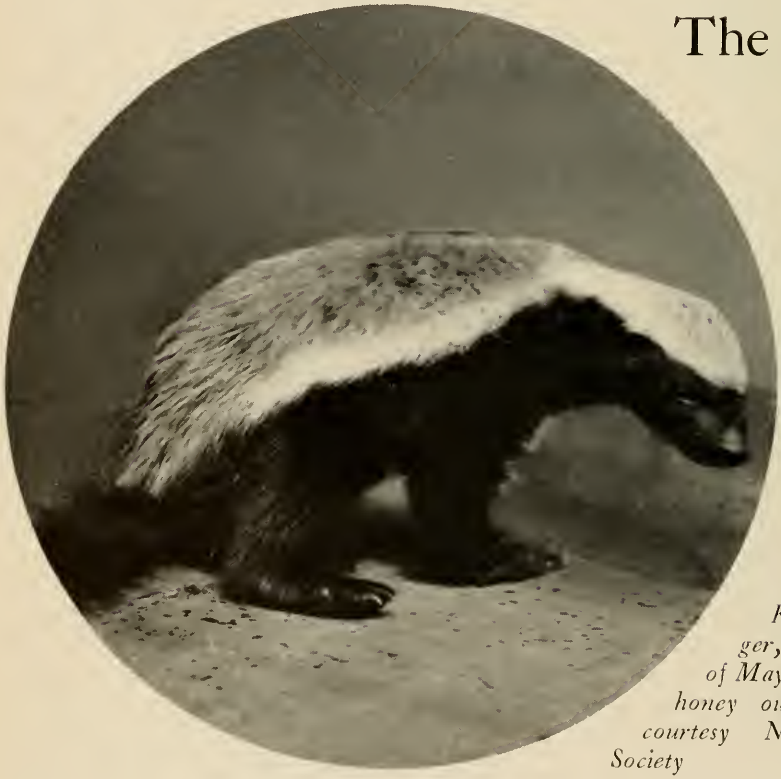
In the dry season this will stay there in the same condition in which he left it until he returns for it, but in the rainy season, rain will mix with the honey, and when the sun comes out fermentation will start. After a few days, when Kambole comes back to find his honey, he will be greeted with pleasant odors of honey beer. This is just fine and our little friend begins to lap it up with great glee. Pretty soon the world looks very good to him and his feet begin to take him scampering around. He rushes about, first in a circle and then back and forth, tearing up the dirt and grass in his enthusiasm. This is how the torn-up areas are produced such as the one that had attracted my curiosity.

Finally he gets exhausted and sleepy and goes to some secluded nook, perhaps an old ant-bear burrow, for a long nap, and all the forest will say, "Kambole has been drinking again."



Three poses of Mayimba, the African honey guide, which leads both man and honey badger to bee hives and, when the honey is secured, shares in the spoils. Herbert Lang photos

The Honey Seekers



Kambole, the honey badger, which takes advantage of Mayimba's guidance and digs honey out of the tree. Photo, courtesy New York Zoological Society

(Right) Natives reaping their reward after heeding Mayimba's advice. Note faint smoke in the center of the picture. By burning a few wisps of grass, sufficient smoke is produced to subdue the bees

(Below) A part of the author's group trekking in Northern Rhodesia. In the dry season the natives burn all the dried grass to make the going easier. Here the smoke pall still hangs over this open space

The evenly spaced, flat-topped trees shown in the above picture are characteristic of the general landscape of Northern Rhodesia. The horizon is about thirty miles distant from the point where this photograph was taken

(Left) A newly made road that shows what the "bush" looks like from within. Following the line of least resistance, the natives walk in the wheel tracks, as this is easier on their bare feet

Luiswishi River in the flood season. Vistas such as this are rare in Northern Rhodesia, for, due to the flatness of the country, most of the rivers are sluggish and swampy. Much of Rhodesia is well watered and suited to agriculture

(Right) A typical Kaonde native. These people obtain nearly all the sweets they enjoy by following the chattering of the honey guide to the hives of honey bees

A National Park in Embryo

Approximately five hundred square miles of territory in southeastern Utah which is rich in treasures of historic value and in natural beauty

By C. S. PULVER
Secretary, Utah State Museum Association

IN southeastern Utah lies a little known area some forty miles long by ten to fifteen miles wide that is destined before long to become one of the show places of the nation. Because of its inaccessibility "Circle Cliffs," as this region has been named, has seldom been visited by other than cattlemen and sheepmen who doubtless little appreciated that this grazing ground for their herds was a potential national park of wide appeal.

This great oval piece of territory is enclosed by walls of Jurassic sandstone from 500 to 1800 feet in height, through which are no more than half a dozen openings, none of which is wide enough to permit the passage of a vehicle. Extending across the eastern end of Wayne, Garfield, and Kayne counties, it lies just under Aquarius Plateau, from which rises one of the highest forests in the world.

Investigating a rumor

One day early in last December a party of four, consisting of an archæologist, a photographer, a cook, and myself as leader, set out for "Circle Cliffs." The interest of the Utah State Museum Association had been aroused by rumors of this unique spot reputedly rich in archæological treasures, bewildering displays of the results of erosion by wind and water, and magnificent examples of petrifaction, all laid in a setting of extraordinary beauty. A brief preliminary trip had been made in November, but we now were determined to make a thorough survey of the region.

At Torrey, where the paved highway ends, we outfitted ourselves for the long trek, and obtained a guide and nine horses. From Torrey we made our way to the "Wildcat" ranger station, a distance of twenty-two miles, and through the courtesy of the forest ranger were permitted to enjoy its shelter for the night. Officially the station was closed for the winter.

Beginning the trek

Morning broke cold and gray, with a hint of snow in the air, for this was about 10,200 feet above sea level. For approximately five miles our party made use of the wagon road recently built by the CCC boys, then, having reached a stockman's camping ground known as "Round Up" it was necessary for us to take to the trails.

Traveling almost due east from "Round Up" to Steep Creek about three miles, we followed down the Steep Creek trail, so named because of the many springs which gush forth on this steep mountain-side at about 10,000 feet altitude. These springs later form several lakes and a fair-sized stream during the wet season, supplying water for the stockmen and their stock, though a great deal of it is lost in the porous sandstone as it travels down into the cliffs.

Travel is slow on the trail leading through heavy oak brush down to what is known as "Indian Trail," the only entrance to the Cliffs from the north end. "Indian" is a hard trail, descending 1800 feet to the floor of the oval in less than a mile. Everybody in our party walked, and liked it. At the bottom of the oval we had to zigzag in and out of knifelike gashes and gulches which had been formed by the eroding waters of maybe 200,000,000 years. Water was plentiful here, but within a few minutes we were again in arid country.

The pack train made twenty miles the first day, and camped for the night at what is known as Moqui Cañon, where are situated the Moqui tanks, and the ruins of the dwellings of prehistoric humans.

The morning after our arrival at Moqui Cañon we were somewhat handicapped by snow, mist, and rain. For two days no photographs could be taken, but the ruins were located, measured, and investigated as thoroughly as possible considering the snow-covered ground. No artifacts were discovered, but the depth of the loose dirt on the floors of the ruins indicated that they had been unoccupied for perhaps more than a thousand years. This area would appear to be worthy of exhaustive exploration.

Our archæologist believed that one of the ruins had been a two-story dwelling. If excavation proves this to be true, it will be the only reported dwelling of its kind north of the Colorado River, and will show that Pueblo III culture crossed this natural boundary. It has hitherto been thought that the river formed an effective barrier to the spread of this greatest of Puebloan periods. Further antiquarian discoveries were made in the northern end of the Cliffs oval, and some artifacts were found. The prehistoric dwellers in this section evidently used the fossil wood for making their knives, arrow heads, and possibly ornaments. We were especially pleased with the discovery of an agatized skinning knife. Chipping grounds were numerous.

The fossil forest

Beginning at Bicknell, eight miles west of Torrey, fossil wood may be found all along the line of the joining of the Triassic and Jurassic formations. The red sandstone cliffs which form the northern boundary of the little valley are of Jurassic sandstone, and "petrified wood" is no novelty there. Stories of the "big" wood, however, which have been told by old timers for the past twenty-five years were believed by few. The members of our party had heard these "tall tales," and while they did not really credit them, felt that they were worth investigating. While we arrived too late in the season for extensive exploration we found sufficient proof that these "tall tales" had not been tall enough to cover the facts.

From the time our expedition reached Moqui Cañon, fossil trees were in evidence, and they appeared all along the route from beginning to end. They probably appear throughout the entire oval, wherever the new red Jurassic sandstone has been eroded to uncover the Triassic, and probably are scattered under the light alluvial deposit which covers the entire floor of the interior of the oval of the Cliffs. At the Moqui tanks, the first discovery was the fossil wood bridge, a tree six feet in diameter and with an unbroken span of twenty-five feet; this was the forerunner of a large number measuring from five to ten feet in diameter, and one with a root system twelve feet in diameter and one hundred and eight feet long.

In the southern area there are many hundreds of trees from six inches to five feet in diameter, hundreds from six feet to ten feet in diameter and with a length of two hundred feet; prostrate monarchs from ten to thirteen feet in diameter, broken in sections and lying extended from seventy-five to two hundred feet.

Wolverine Cañon

It is twenty miles from the Moqui tanks to the southern end of the oval, where lies what is known as Wolverine Cañon; here we found an enormous forest covering anywhere from twenty to thirty miles square. The largest tree found was thirteen feet in diameter at the base, eight feet in diameter thirty feet above the base, and four feet in diameter at seventy-one feet. Reports came to us that there were still larger trees further in the cañon.

There was a profusion of blocks of wood from five to ten feet in diameter. A few standing stumps made us wonder as to their origin —whether they grew here or were floated down from a distant point in some ancient flood. An effort was made to discover if one of the stumps had a root system, but the equipment at hand was insufficient to disinter the base. It may be later proved that these trees grew to mighty stature during the Triassic period, were later covered by the Mesozoic seas, enveloped in the Jurassic sands and clays and saturated with heavy mineral water in which all organic matter became silicified and agatized. Then many millions of years later the floods, the crinkling of the earth's crust, the subsequent erosion by wind and water, and climatic changes brought them forth again.

One most unusual sight was a block of wood superimposed upon a sandstone pedestal, and again upon the fossil wood there was another slab of sandstone. Other parts of the tree lay about the pedestal.

Nature's artistry

The coloring of the fossil wood is so beautiful that only color photography could do it justice. One tree nine feet in diameter and one hundred sixty feet in length, with a seven-inch diameter tip, is a rich golden brown. The general appearance of the natural live wood, —bark, cambium, yearly rings—is retained, while jasper, opal, flint, and chalcedony vie with one another to produce startling effects.

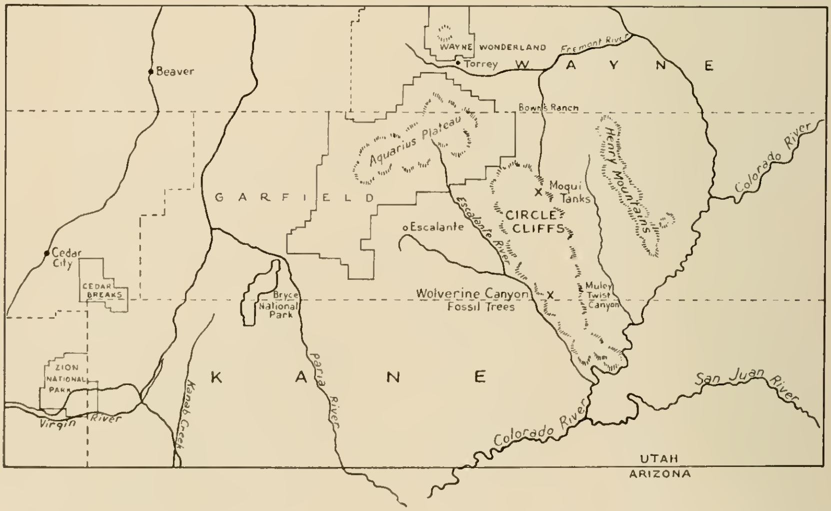
Among the most interesting fossil tree specimens is one four feet in diameter which apparently was hollow. Probably after silicification, this tree was split in two. One part of the heart of the split log is replaced with calcite crystals resembling sawdust, but clear, white, and sparkling under the bright rays of the sun. The other part shows fine garnet-like crystals which have the radiance of thousands of gems. Huge trees and sections of trees, looking as though they had just been sawed through, lie everywhere. Hearts of trees agatized, showing brilliant reds, yellows, purples, lavenders, blacks and browns, glitter in the sunlight.

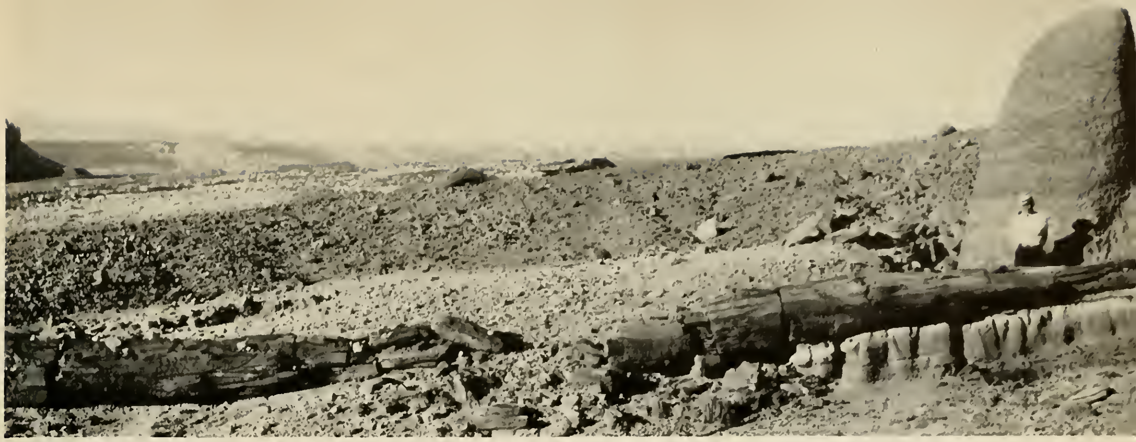
To add to this spectacular beauty, these vast forests of fossil trees lie in and below a riot of color in the Cliff strata. Rising above the floor of the oval is a ledge hundreds of feet high, colored a deep chocolate, which has a capping of brown sandstone. Emerald and sage brush green beds of clay follow, which in turn are topped by red and purple sandstone five hundred feet in height.

Experiences of the Parks Departments of the nation with other fields of this nature have been that vandals have damaged and destroyed valuable relics of prehistoric life. California, Arizona, and even the Yellowstone Park district have had fossil trees almost destroyed by thoughtless tourists chipping pieces from the trunks. To avoid a repetition of this unfortunate situation at Circle Cliffs, an effort is now being made through the State Planning Board to have the entire territory made into a National Park, and to have proper protection given to these fossil monarchs.

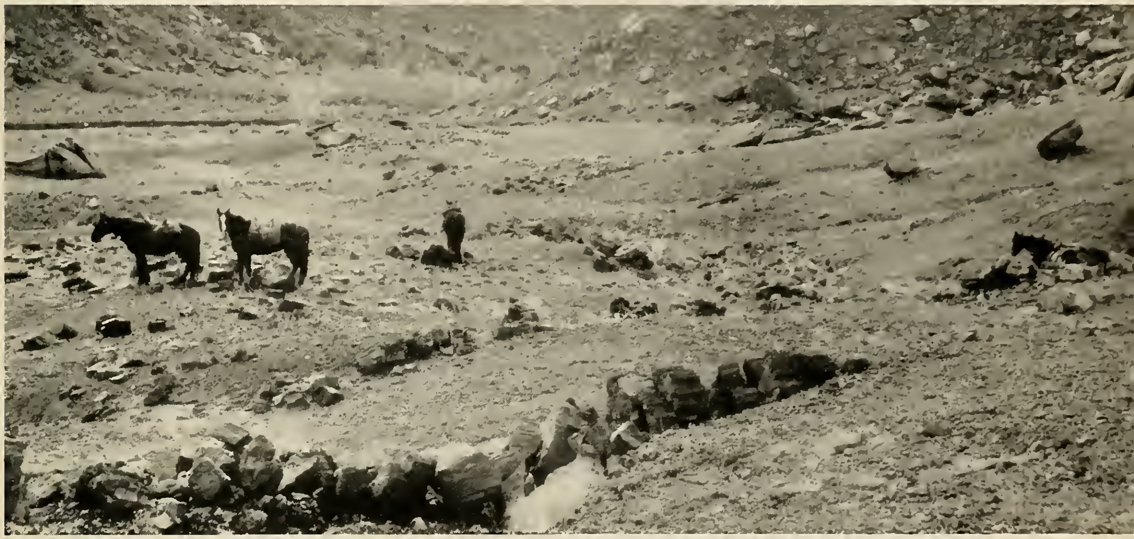
An enforced return

Delighted as we all were with this spot of great natural beauty and historic importance, the approach of a bad storm forced us to start our three-day horseback ride to civilization all too soon. We were cheered, however, by the thought that our trip would be a long step in the direction of bringing the wonders of Circle Cliffs to the attention of the American people.


Beaver
Cedar City
CEDAR BREAKS
ZION NATIONAL PARK
Virgin River
Kanab Creek
Bryce National Park
Paria River
GARFIELD
KANE
WAYNE WONDERLAND
Torrey
Fremont River
WAYNE
Bown's Ranch
Aquarius Plateau
Moqui Tanks
CIRCLE CLIFFS
Henry Mountains
Escalante
Escalante River
Wolverine Canyon Fossil Trees
Muley Twist Canyon
Colorado River
San Juan River
Colorado River
UTAH
ARIZONA

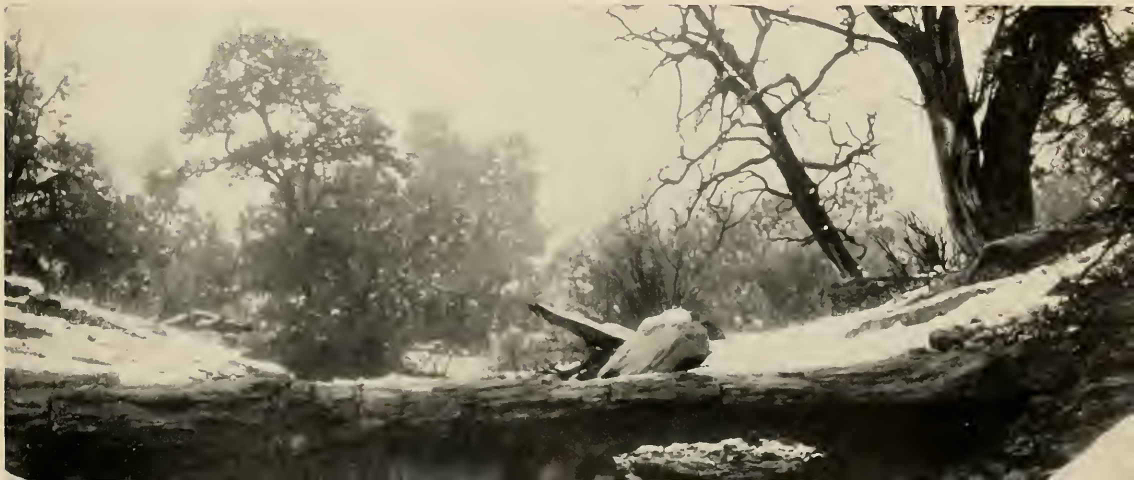


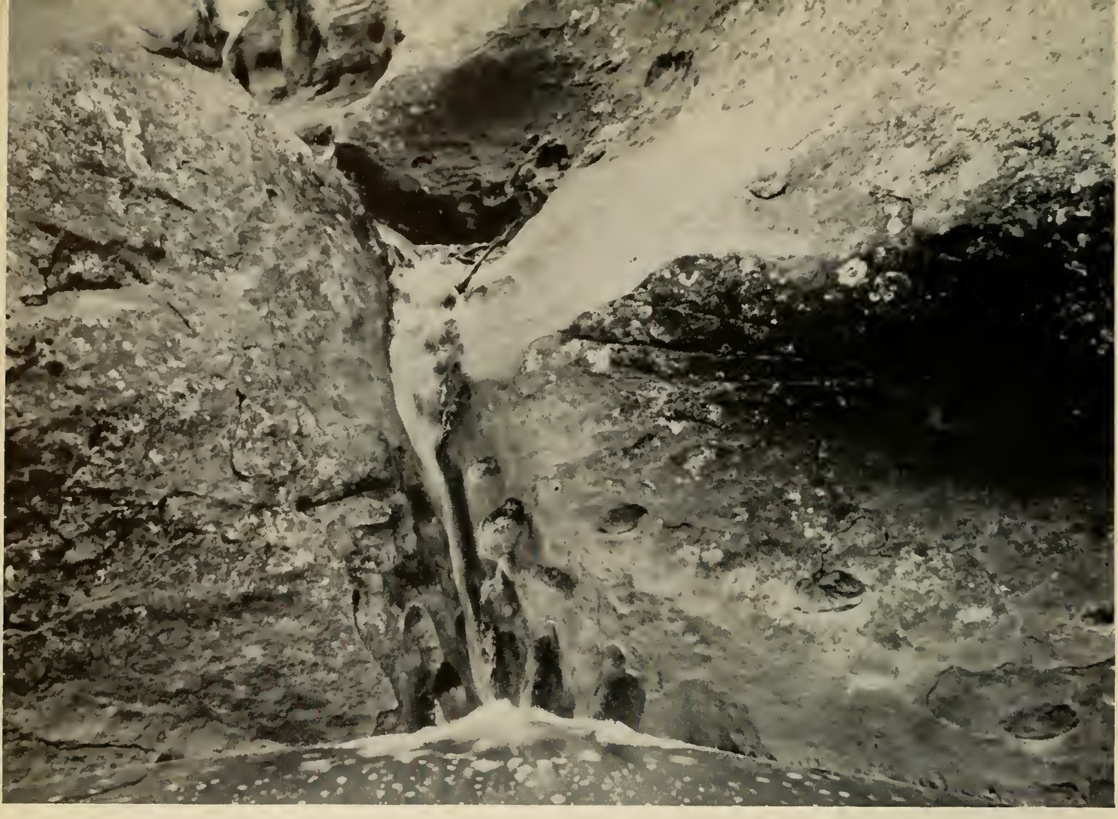
(Above) A section of the enormous fossil forest in Wolverine Cañon, showing one of the petrified monarchs in the foreground



(Above) Where the exploring party of the Utah State Museum Association found a profusion of fossil trees in Wolverine Cañon.

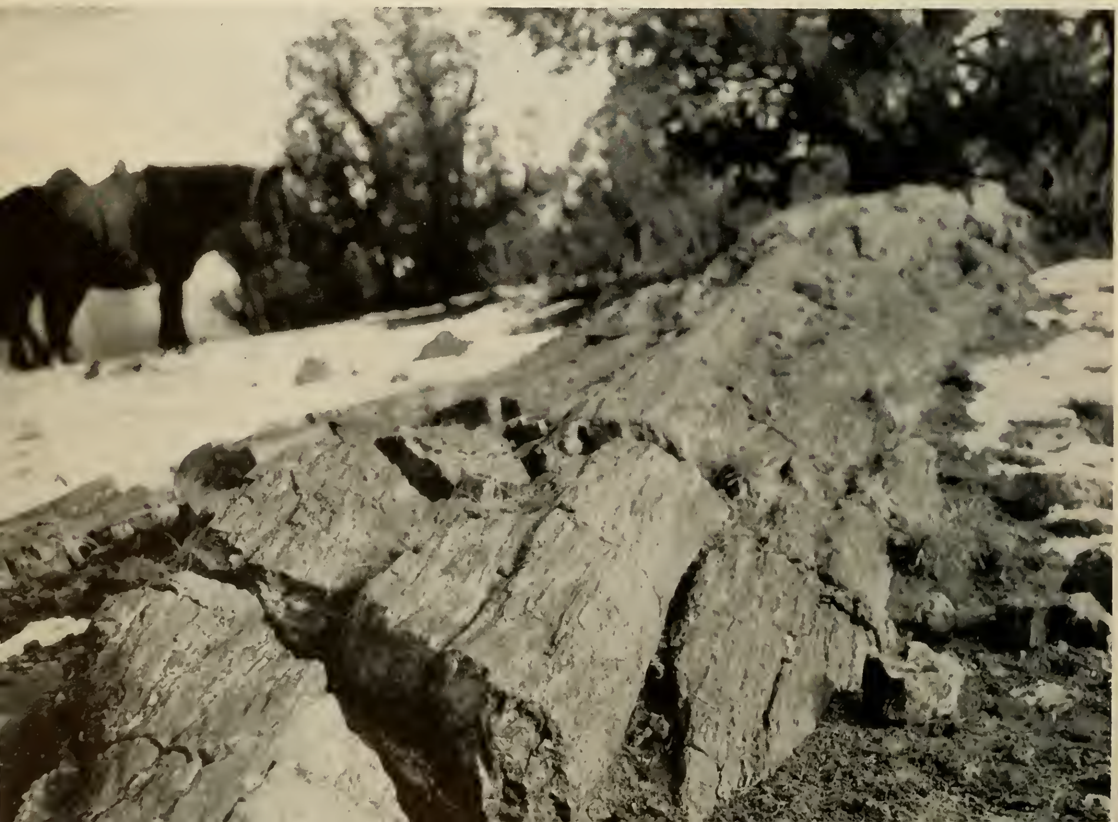
(Below) A fossil tree, six feet in diameter, which provides a twenty-five foot span bridge over a gully





(Above) The Moqui tanks, situated near Moqui Cañon, where remains of ancient dwellings were discovered. The ancient pueblo people always located their dwellings at or near water

(Below) A beautiful specimen of fossil tree found near the Moqui tanks. It is ten feet in diameter at the base, tapering to two feet in diameter at the top

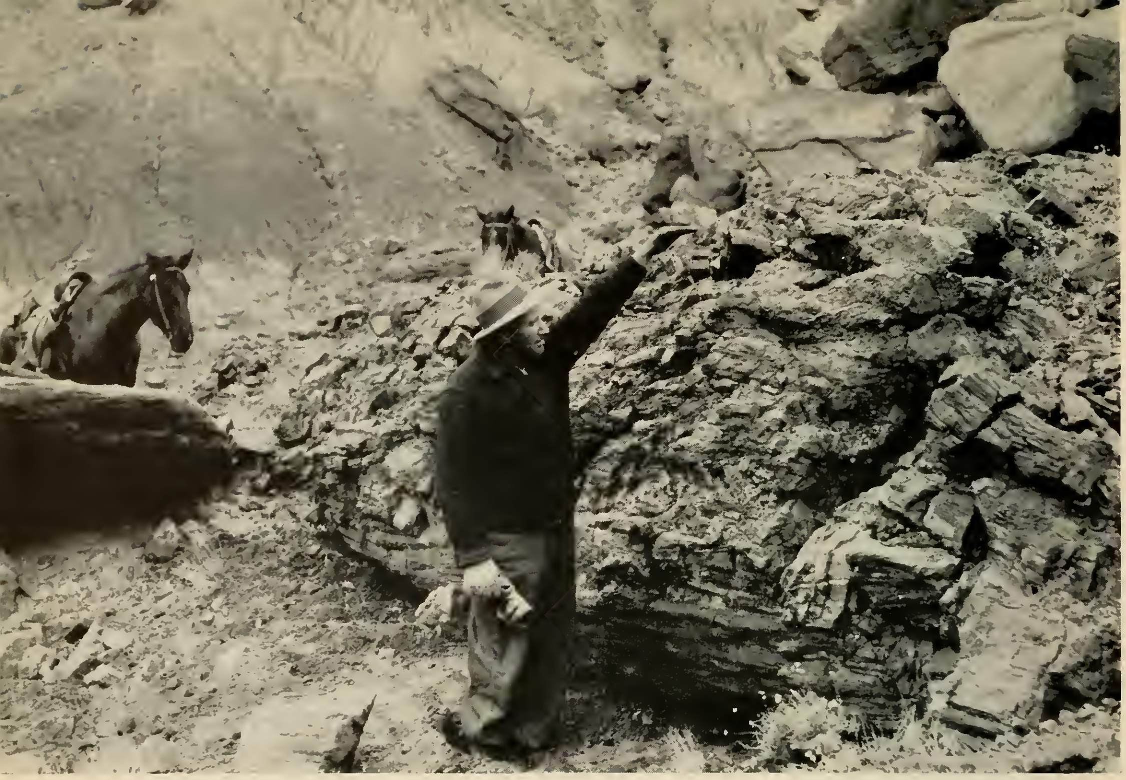


Evidence of prehistoric dwellers in Moqui Cañon which was investigated by the Utah State Museum Association party.

At the right is part of rooms Two and Three

(Below) Interior of the west wall of room Seven which showed the liberal use of mortar

(Left) External view of room Seven, showing the careful alignment of the stone



(Above) The largest fossil tree discovered by the exploring party, located about one mile from the head of South Wolverine Cañon. Its estimated diameter at the base is thirteen feet. (Below) Fossil trees in North Wolverine Cañon

Science in the Field and in the Laboratory

Expeditions, Gifts, Astronomy, Research, Exhibits, Exploration, Meetings, New Publications

Edited by A. Katherine Berger

Henry Fairfield Osborn

A special meeting of the Scientific Staff of the American Museum was called on November 7, 1935, in memory of Prof. Henry Fairfield Osborn, who died on Wednesday, November 6. President Frederick Trubee Davison presided at the meeting. He paid tribute to Professor Osborn as a great scientist, a leading educator, and a distinguished American. Dr. W. King Gregory gave a brief outline of Professor Osborn's life, and Honorary Director Sherwood spoke of Prof. Osborn's more than forty years of service to the American Museum, twenty-five of which were spent as president of the institution.

Dr. Frank M. Chapman then presented the following resolution on behalf of the Scientific Staff:

> *RESOLVED* that we, fellow-workers of Henry Fairfield Osborn in The American Museum of Natural History, express our sorrow in the death of an associate who had been with us for forty-four years, and pay our tribute to his memory as scientist and administrator.
>
> As an investigator he held a place in the first rank of explorers in the field, workers in the laboratory, and student of the writings of others.
>
> As a teacher he was an inspiration in the classroom and lecture hall and through the written word.
>
> As a curator he introduced methods of exhibition which, in their power to attract attention and convey information, have made the halls under his control models of museum technique.
>
> As a President under whose administration our Museum has attained a leading place among the museums of the world, he was never influenced by the expediency of the present but advocated only those standards which would meet the tests of all time.
>
> As a man of the highest ideals, exceptional culture, and wide outlook, he ever saw the results of his own researches in their relation to civilization, and regarded the museum as an educational force of supreme importance in acquainting mankind with the nature of his environment.

The resolution was adopted by a rising vote of all those present.

Arrangements are being made for a memorial meeting to be held in the near future, and a special brochure is being planned as a memorial to Professor Osborn.

Snyder Colorado Expedition

Mr. George G. Goodwin, assistant curator of the American Museum department of mammals, left on Saturday, November 16, for a preliminary trip to Rifle, Colorado, where Mr. Snyder will join him early in December. The expedition plans to spend about one month in the field this fall to collect a series of large and small mammals on the western slope of the Rocky Mountains and will return in the spring to complete the collection.

Childs Frick Nevada Expedition

On October 22 Mr. D. G. Nichols returned to the American Museum with a collection of 450 small mammals, after a four months' trip to the mountains in northern Nevada. The expedition was made possible through the generous support of Mr. Childs Frick, and Mr. W. S. Dana kindly contributed the use of his ranch at Sutcliffe as a base for the field work. The collection included 21 species and an interesting series of desert forms collected at altitudes from 3700 feet on the shores of Pyramid Lake up to 7000 feet in the mountains.

The Davison Alberta Expedition

Through the generosity of Mr. and Mrs. Harry Davison, the American Museum was able to add to its North American collection a series of 280 specimens of mammals from central Alberta.

Mr. T. Donald Carter, of the department of mammalogy, returned on November 4 from a two and one half months' collecting trip, where he was the guest of Mr. Davison at their ranch at Entrance, a locality ideal for collecting. The ranch is at an altitude of about 3200 feet. The country about is composed of open forest of pine, hemlock, poplar, with occasional muskeg and open meadow. A month's collecting was carried on at the ranch followed by four weeks of pack train into the heart of the Canadian Rockies, north of

Jasper National Park. This latter trip resulted in the capture of about 100 mammals at altitudes between 5500 feet to over 7500 feet. Game animals were numerous and the expedition had little trouble in procuring a male and female of the following: Rocky Mountain sheep, goat, mountain caribou, moose and mule deer. The skins as well as the entire skeletons of all the large mammals were saved.

At this writing the specimens have not reached the Museum and consequently have not been classified, but a brief survey in the field discloses the fact that new forms for the Museum are included in the series.

American Museum-Hispaniola Expedition Returns

The American Museum-Hispaniola Expedition has just returned from seven months of exploration in Haiti and the Dominican Republic. Mr. William G. Hassler, leader of the expedition, was the last to leave the field, returning on the Colombian Line steamer "Pastores" with the various specimens collected by the expedition, including about 60 living reptiles and fish. The preserved specimens, which were collected throughout the island, consist of reptiles, amphibians, birds, mammals, land snails, and spiders. These number more than 2000. The Colombian Steamship Company assisted the expedition in many ways and made it possible to send some 430 reptiles and fish alive to the laboratories of the department of experimental biology of the American Museum during the summer. A number of the species secured by the expedition are rare or previously unrepresented in the Museum's collections and some are new to science.

The expedition left New York in the middle of last March. The other members of the party, who were in the field varying lengths of time, were: Mr. Melville P. Cummin, expedition artist; Mr. Daniel C. Pease who continued studies and collections of land snails which he began on the Island two and three years ago; Mr. James H. Hassler and Mr. John M. Bell, assistants.

Equipped with a 1½-ton Chevrolet truck for a traveling base, the expedition made a complete circuit of the Island and many short trips, driving nearly 5500 miles over everything from asphalt paved highways to desert wastes. Collecting was therefore carried on under a wide range of conditions, from cool pine forests on mountain-tops over 5500 feet in altitude to the broiling hot shores of Lake Enriquillo, a large salt lake about 140 feet below sea level. The expedition even invaded the romantic and somewhat awe inspiring atmosphere of the huge old Citadel of Christophe, perched on its mountain-top in northern Haiti. There, in the dark and dripping chambers were found many interesting frogs and snails, while a few lizards and snakes were collected in the courtyards of the old building. While none of the snakes found in Hispaniola are poisonous to man, the people of the Island share the average northerner's fear of the animals. A number of caves were also visited, principally on Samaná Bay and at La Romana, from which a series of bats was taken. Two specimens of a large rodent, one of the few mammals native to Hispaniola, were secured alive but both died soon afterward, probably due to injuries received when captured by the peasants. They resemble large muskrats but are not aquatic and instead forage clumsily in trees for food.

The expedition was organized primarily to study the social habits and life histories of tropical reptiles. Experimental methods for this work had been worked out at the American Museum's field station at Crossley, New Jersey (see NATURAL HISTORY, January-February, 1934). Numerous experiments with marked individuals were performed in the field. The results of these studies will be coördinated with the social studies previously made on American species.

Throughout its stay in the two Republics the expedition was materially assisted by both the Haitian and Dominican governments and everything was done to expedite the work of the members. The expedition was privately financed.

—W. G. H.

A Gift to African Hall

Major Max C. Fleischmann, of Santa Barbara, California, has most generously donated the funds for the mounting of the Wild Dog Group on the mezzanine floor of the Akeley Memorial African Hall.

Although the wild dogs are among the most interesting fauna of Africa, the original plan for the hall did not include representing them, as they are very rarely seen and a collecting expedition might search for a year or more without running across a pack. As a matter of fact, Mr. Akeley took the specimens only by a lucky chance, happening to sight them unexpectedly one morning at sunrise as they came up over an ant hill and stopped to gaze at a grazing herd of animals off in the distance. Taking advantage of the unusual opportunity, Mr. Akeley brought down several of the dogs, hoping that some day it might be possible to have them featured in a group.

The design of the Wild Dog Group, created by Dr. James L. Clark, director of arts, preparation and installation at the Museum, shows the pack very much as Akeley saw them, tensely at attention on the crest of the ant hill, their fierce gaze focussed on their quarry, preparing for swift attack.

Thanks to the timely and substantial gift of Major Fleischmann, the wish of his old friend, Carl Akeley, for a spectacular group of the African wild dogs is to be realized.

The Galápagos Group

The Crocker Pacific Expedition has brought to the American Museum several magnificent specimens of the marine iguana, a species peculiar to the Galápagos. These have afforded an occasion for rebuilding the Galápagos group in the Reptile Hall. Karl P. Schmidt, formerly assistant curator of the department of herpetology in the American Museum, discovered, while a member of the Crane Expedition of the Field Museum, that the extraordinary mass of tubercles which protrude from the head of this species are used by the males in their butting contests for favorite territories. Each adult male marks out for himself a suitable spot for sunning and drives other males from this area. This acquisition of territory plays an important part in the social life of the species and it seemed highly desirable to incorporate the fact in our habitat group already prepared. Consequently the two best males secured by the Crocker Expedition were mounted in the position of attack, with lowered head and sprawling legs. They were then placed in the dominant position in the group and the other iguanas rearranged to represent a typical herd. The rearrangement has greatly improved the group. It not only adds an important new fact to the life story portrayed, but it makes the artistic arrangement more pleasing.—G.K.N.

The Hayden Planetarium

The lecture in the Hayden Planetarium is being changed monthly. Following is the schedule for 1936.

December (1935)—Christmas Lecture
January—The Winter Constellations
February—Eclipses
March—The Seasons
April—The Southern Cross
May—The Planets and Their Motions
June—The Midnight Sun
July—The Summer Constellations
August—Comets and Meteors
September—Timekeeping and Navigation
October—Five Thousand Years in the Past-Precession
November—Stars and Nebulae
December—Architecture of the Universe

Each lecture opens with a brief description of the projection instrument.

From the opening of the Hayden Planetarium on October 3 to November 15, there has been a phenomenal attendance of 165,304. Of this total, 29,590 were public school children admitted in class groups free of charge.

The schedule of Planetarium performances is as follows:

Mornings (except Sundays, and Holidays) 11 o'clock	25 cents
Saturdays only 10 a.m. and 1 p.m.	25 cents
Afternoons (Daily, Saturdays, Sundays, and Holidays) 2, 3 and 4 o'clock	25 cents
Evenings (Daily, Saturdays, Sundays, and Holidays) 8 and 9 o'clock	35 cents
Reserved Seats (Daily, Saturdays, Sundays, and Holidays)	
Afternoons 2 o'clock	50 cents
Evenings 8 and 9 o'clock	60 cents

Doors close promptly on the hour, after which no one is admitted. Children under five years of age will not be admitted.

A Special Series of Planetarium Lectures

The officials of the Planetarium have been deluged with requests for a series of lectures on specific astronomical subjects, which can be interpreted in a fascinating manner with the help of the Planetarium instrument. Therefore, to meet this demand a series of six lectures is to be given. Already the response indicates a well-attended series. The lectures are to be held on alternate Thursday evenings at 6 p.m., beginning November 21, 1935.

The lectures deal with the following subjects:

November 21—Time and its Measurement—How Time is Distributed Over the Nation.

December 5—Variable Stars and How They are Useful.

December 19—The Seasons—Cause of the Seasons—Length of the Day and Seasonal Lag.

January 2—The Romance of the Zodiac—The Constellations and Their Probable Origin. The Signs of the Zodiac, Their Origin and Meaning.

January 16—The Calendar—The Lunar Calendar—The Solar Calendar—The Gregorian Calendar.

January 30—The Size and Shape of Our Stellar Universe—The Milky Way—Star Ratios—The Magellanic Clouds and Structure of Our Universe.

Lantern slides will also be used in conjunction with the Planetarium Instruments. The lectures will be delivered by William H. Barton, Jr., associate curator. A subscription fee of $2.50 covers the six lectures. All those interested are cordially invited to attend. Admission to any individual lecture can be had only by subscribing to the entire course.

Amateur Astronomers Association

On Wednesday, December 4, at the regular meeting of the Association in the large auditorium of the American Museum, at 8:15 p.m., Mr. J. W.

Fecker will speak on "Astronomical Engineering." On December 18 the meeting will be an open forum with discussion by the members of the society.

Coöperation with Educational Institutions

Special Museum instruction is being continued with selected groups of students from the senior class of the department of education of the College of the City of New York. These students are instructed in Museum techniques and are given opportunity to do practice teaching in the Museum. In addition, other groups of City College seniors, some of them graduate students, have been accepted, at the request of the College, for observation and practice teaching at the Museum. Each of the groups complete an intensive four weeks' course.

The free daily planetarium showings at 10 A.M. and 1 P.M. for classes from the public schools of Greater New York have been eagerly taken advantage of by thousands of children from the five boroughs. At these showings the planetarium chamber has been filled to capacity and numerous requests for seats have had to be postponed to later dates.

On the evening of October 22 more than 100 members of the Municipal Club of Brooklyn held a very successful dinner meeting at the American Museum. Dr. Walter Granger spoke on "Explorations in the Gobi Desert." Later the group visited the Hayden Planetarium and attended the nine o'clock showing.

On the evening of October 30 about 75 members of the Union League Club of Brooklyn held a similar meeting at the Museum and the planetarium. On this occasion Dr. Roy W. Miner spoke on "Diving in Coral Gardens," an account of some of his field work in the Bahamas in preparation for the Coral Reef Group.

Other evening dinner meetings were arranged for the New York Principals' Association on November 16 and the Junior High School Principals' Association on November 23. At both of these meetings Dr. George H. Sherwood spoke on the educational services of the Museum to schools of the city, after which the groups attended showings at the Hayden Planetarium.

In coöperation with Mr. Forest Grant, director of art in the city high schools, the department of education of the American Museum has been sponsoring a contest of Hayden Planetarium posters by high school art students. These posters were on view in Education Hall from November 20 to December 2, and the prize winners will be on view in the Hayden Planetarium for several weeks.

Greater numbers of school children are attending the special activities crafts classes at the American Museum than ever before. These classes are given in connection with the Exhibition Hall Talks and consist of Finger Painting, Geography Crafts, and Miniature Group Making. Since September 30 when the classes opened, about 2000 school children have attended them, and many requests have had to be postponed.

The Exhibit of Live Scorpions and Spiders

Showing live scorpions and spiders to daytime visitors is beset with the difficulty that those animals are really active only at night. Perhaps with apparatus that would "reverse the day" this difficulty might be overcome. But, even then, we would still have difficulties with food and other factors.

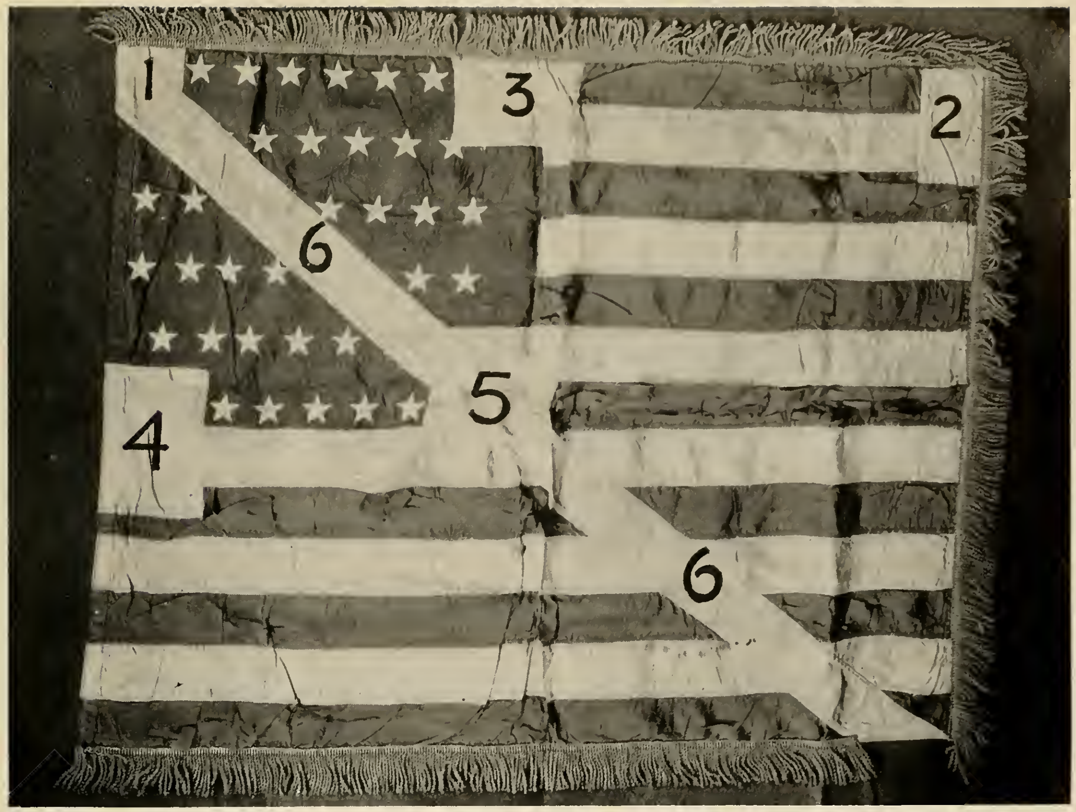
This was well illustrated in the case of the baby scorpions that were recently born in the exhibition cages at the American Museum. One mother had eight children and another had four. As is their custom, the young climbed on to their mother's back. Normally they would stay there for about two weeks, during which time they apparently do not eat. Then they molt, greatly increasing in size, and leave to forage for themselves. All of the babies that we had on exhibition died under the glare of the lights there, but the mother with her brood of four that we have been keeping in more normal conditions still has three of them.

The black widow spider continues to attract attention—rather more attention than it deserves. There is no doubt concerning the great potency of its venom, but the spider does not go about seeking people to bite. Really it is very much of a hermit under stones and in crevices. The fact that it has been in the vicinity of New York City for many years, probably since before man came, shows how little is the danger to us.

Biological Research

Dr. R. W. Root, assistant professor of zoölogy at the College of the City of New York, has joined the staff of the laboratory of experimental biology at the American Museum as a guest investigator. He is the second member of the biological staff of City College to coöperate actively in the research program of the laboratory. Dr. William Etkin, instructor in biology at City College, has for some months been carrying forward his studies on the relation of hormones to growth, metamorphosis, and pigmentation in Amphibia.

The laboratory staff is now developing a program of research in several fields of biology. Some indication of the diversity of interest is shown by the papers being presented at the annual meeting of the American Society of Zoölogists this month. These papers include: Sexual selection in fishes. G. K. Noble and Brian Curtis; The sensory mechanisms involved in the migration of newly-



Carried to the Top of the World

This historic flag, carried to the Polar regions by Peary, is the gift of Mr. David B. Hampton to the American Museum. The story of its numbered sections is told below on this page

hatched fresh-water turtles. G. K. Noble and A. Braslovsky; The effects of ovariotomy and hypophysectomy on parturition in snakes. H. J. Clausen; Hypersensitiveness of the pars intermedia as a graft in the tadpole. William Etkin; On the development of the thyrotropic function in the hypophysis of the tadpole. William Etkin.
—G. K. N.

Peary's North Polar Flag

One of the flags which the late Rear Admiral Robert E. Peary carried to the top of the world and a duplicate of the one which he nailed to the North Pole on April 6, 1909, has just been presented to the American Museum by Mr. David B. Hampton of New York. Peary presented this flag to Mr. Hampton shortly after returning from his trip to the pole and it has been in Mr. Hampton's possession ever since. Mr. Hampton realizing the historical significance of this flag has turned it over to the Museum for preservation and display in its Polar Exhibit.

The flag has special exploratory and historical interest. It was made by Mrs. Peary in 1898 and was carried by the explorer on his various dashes toward the Pole. A cover design, a photograph, and a brief description of the flag appeared in *Hampton's Magazine* for February, 1910. Peary made five excerpts from this flag and placed them in cairns at various farthest north points reached on his successive dashes toward the Pole. At least one star and a piece of the red and white stripes was left with the explorer's records at each of five places. The pieces marked 1 and 2 were left at Cape Morris K. Jesup, lat. 83° 39″, the farthest northern point of land in the world, May 16, 1900. No. 3 was left at Cape Thomas Hubbard June 27, 1906. No. 4 was left at Cape Columbia the northernmost point of Grant Land June 8, 1906. This was also the starting point for the 1906 and 1909 dashes for the Pole. No. 5 was left in the ice of the Polar Sea at latitude 87° 6″ April 21, 1906, Commander Peary's "Farthest North" of that year. No. 6 was left at the North Pole April 6, 1909. Peary thus left parts of this flag at the North Pole and at the ice shrouded extremities of the three most northern bodies of land in the world.

On April 28, 1914, D. B. MacMillan and

Fitzhugh Green of the 1913-1917 Crockerland Expedition arrived at Cape Thomas Hubbard and found a substantial cairn, stick at the top and a cocoa tin at the base, containing a section of a silk flag and a brief record which read: "Peary, June 28, 1906." MacMillan in his report of 1928, page 397, states: "The flag and the record were presented to the American Museum upon my arrival in New York. In the cairn I replaced a copy of the record, also a small American flag and a record of my own which read:

APRIL 28, 1914

"Arrived here to-day from a point on Polar Sea 125 miles northwest true from here. Leave tomorrow for Cape Colgate, thence for Etah, Greenland."

(signed) D. B. MACMILLAN
FITZHUGH GREEN

Thus the No. 3 section of Peary's flag was recovered and returned to New York. Now that the original flag has been received, excerpt No. 3 can be placed in the gap to show that Peary's exploration of Cape Thomas Hubbard has been confirmed.

—CHESTER A. REEDS

The Ernest Shoemaker Collection

A unique archæological collection, comprising some 3000 numbered and catalogued specimens derived from the District of Columbia and immediate surroundings, was recently presented to the American Museum by one of its faithful members, Mr. Ernest Shoemaker of Brooklyn.

Mr. Shoemaker was born in Washington, D.C., and spent the early part of his life in the capital city. As a boy of twelve he became interested in Indian relics and soon made a hobby of collecting surface specimens. His finds were obtained mostly from plowed fields which had once been village sites lining both sides of the Potomac and Anacostia rivers. For a period of fifteen years and until business interests brought him to New York city, Mr. Shoemaker devoted most of his spare time to this task, the collection now available for exhibition and study being the result.

The Shoemaker collection is made up largely of chipped stone implements, such as spearpoints, arrowpoints, drills, knives, scrapers, chisels, celts, and hoes. A moderate number of ground stone implements, including hammerstones, pestles, sinkers, celts, grooved axes, pipes, pendants, fragmentary gorgets, bannerstones and birdstones, are also present. The remainder consists of fragmentary soapstone vessels and potsherds, the latter of which exhibit both stamped and incised ornamentation.

To complete the story, it must be said that Mr. Shoemaker several years ago supplied 1000 of his choicest specimens to the Museum to serve as a special Loan Exhibit. This exhibit can now be enlarged and made fully representative. All things considered, the Museum may consider itself fortunate in having been made the recipient of this generous gift, because with the rapid expansion of the city of Washington no similar collection is likely ever to be brought together in the future.

—N. C. NELSON

The Lure of Archæology

"The Lure of Archæology" was the subject of a radio talk presented on Tuesday, October 22, 1935, by Mr. N. C. Nelson, curator of prehistoric archæology at the American Museum. The talk was given under the auspices of Science Service, over the Columbia Broadcasting System.

Annual Meeting, N. Y. Academy of Sciences

The New York Academy of Sciences and Affiliated Societies will hold their annual meeting and dinner on Monday evening, December 16, 1935, in Maxwell Hall of the American Museum. After the diner and business of the evening, there will be a program of botanical nature. The retiring president, Director Marshall A. Howe, of the New York Botanical Garden, will deliver his presidential address entitled "Plants that Form Reefs and Islands," illustrated by lantern slides. A series of botanical motion pictures will also be shown by Director William Crocker of the Boyce Thompson Institute for Plant Research entitled "Time Lapse Motion Pictures of Plants." Members of the Academy and Affiliated Societies and their friends are cordially invited. Tickets $3.00. There will be music.

Sequoia Chosen as Our National Tree

The National Life Conservation Society last summer invited the schools, churches, lodges, and clubs of the United States to take part in a nation wide poll to determine which tree shall rank as its national tree. Mrs. Charles Cyrus Marshall, founder-president of the organization, announced at the close of the poll that the Sequoia had received the largest number of votes.

The total number of votes was more than 2,730,000, of which 788,155 were cast for the winner. The American elm stood second with a total of 754,756 and the pine took third place with a count of 666,677. Other trees voted for were the black walnut, hickory, willow, locust, dogwood, and tulip tree.

The giant Sequoia of the west coast of North America is found nowhere else in the world, although science declares that it was once found on four continents. Fossilized remains of Sequoia were recently discovered in France. Some of the California Sequoias are believed to be between 3000 and 4000 years old.

Frederick Webb Hodge Anniversary Publication Fund

In December of 1886, Dr. Frederick Webb Hodge joined the Hemenway Southwestern Archæological Expedition to Arizona, and began a career in anthropology which will reach its fiftieth anniversary in 1936. The occasion is to be marked by the creation of the Frederick Webb Hodge Anniversary Publication Fund, under the guidance of the following Sponsoring Committee: H. B. Alexander, Franz Boas, Herbert E. Bolton, Fay-Cooper Cole, Carl E. Guthe, E. L. Hewett, Ales Hrdlicka, A. V. Kidder, Jesse L. Nusbaum, Bruno Oetteking, Elsie Clews Parsons, Edward Sapir, Frank G. Speck, A. M. Tozzer, Henry R. Wagner, Clark Wissler. This Committee will appoint an editorial board, self-perpetuating, to select works in the field of American anthropology for publication by the Fund. Southwest Museum, of which Doctor Hodge has been director since 1932, will administer the Fund as an endowment trust.

All publications will be sold, at approximate cost, the income of the Fund being used as a reserve to meet the heavy initial cost of printing and to cover possible deficits. Contributors to the Fund who so desire will receive a *pro rata* credit on its publications, enabling them eventually to recover in publications the amount of their contribution in dollars. Contributions should be sent to Hodge Fund, Southwest Museum, Los Angeles, California.

Doctor Hodge is one of the pioneers of American anthropology. A founder of the American Anthropological Association, he edited its journal the *American Anthropologist* during its first fifteen years, meeting much of the initial expense from his own pocket. The *Handbook of American Indians North of Mexico,* always the standard work of reference on this subject, is but one among many of his editorial and original contributions to the study of aboriginal America. Doctor Hodge headed the Bureau of American Ethnology for eight years. His long career has been one of constant support and encouragement to the study of American prehistory. The Fund which is to bear his name offers to his many friends and admirers an opportunity to do him personal honor, at the same time increasing the meager existing facilities for publication of research in the important field of American prehistory.

Recent Museum Publications

NOVITATES

No. 820. Birds Collected During the Whitney South Sea Expedition. XXX. Descriptions of Twenty-Five New Species and Subspecies. By Ernst Mayr.

ANTHROPOLOGICAL PAPERS

Vol. XXXV Part ii.—Excavations at El Arbolillo. By George C. Vaillant.

Vol. XXXV Part iii.—Early Cultures of the Valley of Mexico: Results of the Stratigraphical Project of The American Museum of Natural History in the Valley of Mexico, 1928-1933. By George C. Vaillant.

RECENTLY ELECTED MEMBERS

A REPORT from the membership department lists the following persons who have been elected members of the American Museum:

Life Members

Messrs. Thatcher T. P. Luquer, Samuel H. Ordway, Jr.

Sustaining Member

Colonel Howard Stout Neilson

Annual Members

Mesdames Union Noble Bethell, Ambrose Day, Henry B. Eaton, S. J. Freudenheim, William K. Gregory, Waldo S. Kellogg, James G. McNary, Frances Meadow, George Simpson, J. Wickliffe Throckmorton.

Sister Mary Scholastica

Misses Mary Elizabeth Allanach, Edith G. Bowdoin, Lucy Kaufmann Broido, Esther G. d'Eustachio, Frances H. Dickerson, Mary W. Dobson, Isabella W. Jex, Mildred E. Kamner, Katherine O'Brien.

Hon. Chief Justice Charles E. Hughes

Doctors Richard M. Andrew, Joel B. Hayden, Isaac M. Heller, S. H. McEvoy, Jesse B. Stark.

Professor Jarvis Keiley

Hon. Charles S. Whitman

Messrs. Edward F. Addiss, Earle H. Balch, P. S. Benukh, Frank J. Bischoff, Jr., Robert Bridges, Walter L. Buchanan, G. Edward Buxton, Louis S. Cates, Frederic Strohmeyer Cluthe, J. F. B. Erdlets, Jr., James L. G. FitzPatrick, Albert Forsch, George B. Francis, Herman Goldberg, Frank S. Hackett, L. Boyd Hatch, John Price Jones, Milton Kahn, William D. Kleinpell, Constantine P. Lent, Franklin B. Lord, Lingard Loud, David H. McAlpin, Stephen Paine, Donald Q. Palmer, E. W. Parker, Thomas J. Ryan, James R. Sheffield, Lionel F. Straus, H. Theodore Stubbs, Radcliffe Swinnerton, Robert J. Tucker, Egbert M. Turner.

Associate Members

Mesdames Marston Allen, Emma H. Austera, Wm. H. Berghman, Charles M. Betts, Russell W. Brandt, Ellsworth B. Buck, Frank C. Buckhout, Richard Chute, Roger P. Conklin, Homer F. Cox, William H. Darken, Edgar N. Dickson, George H. Earle, Susan Ellithorp, Jos. Felsen, Lillian S. Fisher, C. P. Greene, Leah Haber, John Hawes, Edwin A. Hayes, D. M. Keith, G. J. Kendall, Charles W. Keyes, E. M. Keys, Catherine T. Larssen, A. C. Leisenring, Alfred W. Merian, Callie H. Olson, Walter Phillips, Alexander Stewart Phinney, O. B. Potter, Marshall L. Price, A. B. Rabold, H. W.

Soper, Edgar Stillman, Ernest Sturm, D. Everett Taylor, Barbara E. Tindall, David Walton, Harry H. Warfield, Richardson White, Frederick P. Wilcox.

Mother M. Alphonsus

Misses Margaret C. Albright, Lorene Bailey, Lillian Balensiefer, Elizabeth Barrett, Cecilia Bartsch, Millicent Baum, Constance Caroline Becker, Esther Lewis Bernfeld, Alberta Braden, Grace L. Brooke, Keith Brown, Marion Brown, Louisa Bruckman, Mathilde J. Brunswick, Annie Payson Call, Bessie Campbell, Alice L. Carlisle, Gertrude Cohen, Sudie E. Cowden, Mary V. Daughtrey, Irene L. Dearing, Elizabeth De Niord, Louisa L. Dresel, Luella L. Ebert, Irene C. Elliott, Mary E. Felter, F. Belle Figger, Nancy Fitzwilliams, Lili C. Gaedeke, Edna S. Goetschius, Molla J. Greenberg, Carolyn Griswold, Grace Hillabrand, Evelyn Marguerite Hunter, Veronica C. Keegan, Josephine W. Kenny, Mabel Kilcullen, Nancy A. Klingensmith, Stella Krabbenhoft, Katherine Krout, Hortense D. Loiselle, Harriet Marie Luckner, Gertrude E. Macpherson, Flossie Martin, Minnie M. Martin, Doloris McDonald, Frances Mittelman, Cecilia Mohs, Mathilde Moser, Olga Erbsloh Muller, Therese B. Nicht, Mary Dora Rogick, Grace B. Ross, Juanita Maxine Ross, C. M. Rudolph, Marion N. Russell, Elsie M. Schauli, Mildred E. Schroeder, Elvira Seno, Harriett A. Sleeper, Dorothy Smith, Elizabeth Sprenger, Suzanne Northrup Taft, Minnie Mae Tims, Edrine Tyson, Gertrude L. Waldo, C. Jeannette Wallace, Edith Ward, Zadie H. Ware, Martha M. Weaver, Paula R. Wesner, Gertrude M. Wheeler, Arlene I. Whittemore, Elizabeth A. Williams, Theo. J. Wilson, Grace G. Wolcott, Tillie Wolk, Marie B. Woodruff.

Reverends P. J. Blanc, Earle A. Brooks, John F. Droste, Francis P. Heavren, Mark Kelley.

Colonels Leopold Philipp, Arthur N. Tasker.

Major Edward W. Macy

Doctors L. G. Bailey, Louise Stevens Bryant, Frank T. Budd, Arthur C. Cole, Jr., F. P. Denny, Henry C. Ferris, A. C. Fraser, Stephen Ivanoff, L. Everett Jaquith, L. Vosburgh Lyons, Claude B. Norris, William H. Oates, John Sealy Peek, John R. Richardson, Frank Rohr, Jacob Rosenblum, Carl Alois Schwarze, Aaron M. Solomon, I. Sossnitz, Alfred R. Starr, Henry Bruner Sutton, John M. Wheeler, DeForest P. Willard.

Messrs. C. C. Aird, Charles W. Albright, Norman Allderdice, Ernest L. Allen, M. Q. Allen, John Angel, Reese Arve, C. B. Atkins, George H. Atkinson, George P. Auld, E. T. Aylesbury.

Alfred B. Babcock, Joseph G. Baier, Henry M. Baker, LeBaron R. Barker, Charles Beaver, Robert H. Becker, Howard Bement, Julius Bergfels, Gustave G. Bielfeld, M. R. Bissell, Zenas W. Bliss, 2d., Frederick Bode, Jr., Wilfrid A. Bonin, Walter H. Boone, Joseph Bosch, Richard S. Bower, Lynde Bradley, Joseph R. Brodsky, C. A. Brooke-Cunningham, Don M. Brown, Charles Beckman Bull, D. C. Buell.

A. J. Caillouet, Raymond J. Calvo, A. C. Campbell, Peter F. Campbell, P. R. Cant, John Carey, E. H. Carroll, James M. Carroll, Conrad Chapman, Edward C. Childs, E. R. Clayton, G. T. Corl, Richard A. Corroon, Erskine H. Cox, J. Frederic Cox, Malvin Cox, A. Julian Crandall, Charles E. Crawley, James B. Cullison, Jr., Wilbur L. Cummings.

L. A. Dall, Ernest B. Dane, Jr., Asa H. Danforth, Robert H. Dann, Cecil B. deMille, Ferdinand J. Derge, James Donaldson, G. M. Drake, Chas. E. Dull, Fred S. Durham.

Charles W. Eakeley, Allan R. Edwards, H. F. Egle, Zenas H. Ellis, Howard Epstein.

James A. Fairley, Walter A. Fairservis, Jr., Henry Faurot, M. E. Finck, Joseph Fischer, John Flanagan, W. C. Frey, Wilbert G. Fritz.

W. Roland Galvin, Preston H. Gardner, T. D. Geoghegan, James R. Gibson, Joseph Glicksman, George S. Godard, Ralph W. Grant, Jack Trombley Gray, Charles Greenberg, F. Scott Griswold, Edouard A. Grobet, W. A. O. Gross.

B. Haywood Hagerman, Edward W. Harden, Samuel A. Harper, Robert S. Hartgrove, Albert S. Harvey, J. C. Hathorn, William Hein, William G. Hilton, R. D. Hissong, Curtice N. Hitchcock, Harry E. Hodgson, Herbert S. Hoffman, Oliver R. Hood, Arthur E. Hopkins, August Horowitz, William B. Hubbell, Edward Marion Hughes, Karl Humphrey, David Hunter, Edward S. Hunter.

W. Montgomery Jackson, Ben S. Johnson, David L. Johnson, Eldridge R. Johnson, Maurice Johnson, V. Bernard Johnson.

M. J. Karn, Geo. S. Karsnitz, H. E. Katschke, J. Brown Kelley, Alexander Kirsh, J. E. Klingberg, W. F. Kuntemeier.

Harry F. Landon, Winifield S. Lane, Alan Leamy, Samuel H. Lebowitz, Vernon Lee, Jurian N. Leggett, A. O. Leighton, Lloyd Lemmler, Walter K. Lennox, Leroy E. Leonard, Elgin F. Lewis, Walter S. Little, Frank T. Lloyd, Durban A. Longnecker, Albert C. Lord, William R. Loring, Forest R. Lowrey, E. H. Lundy.

Andre C. Mace, Carleton Grant MacLean, Milton W. Mahlburg, James Mangus, A. Markle, Jr., C. W. Marsh, Arthur L. Martin, James Prescott Martin, Frank J. Mason, William V. Mason, D. H. McConnell, Jr., Willis E. McDowell, Paul W. McQuillen, Rollin Weston Mecker, A. J. Meier, E. L. Messler, Charles H. Metzger, Geo. Meyer, Jr., William S. Millar, Albert S. Miller, Townsend T. Mink, Roger M. Minthorne, James H. Molloy, Frank H. Moloney, Jr., Thos. C. Moore, W. A. Moore, Caspar W. Morris, Ivan Brown Morrison, John E. Muhlfeld.

D. A. Newhall.

Earl H. Oliver, Phillip Oppleman, John O. Orear, Morris Ottenheimer.

William P. Palmer, Jr., William J. Parmelee, Hugh Paterson, Walter R. Peabody, Wingrave H. Peeples, Harold T. Peters, H. L. Pierce, Frederick J. Pierson.

Morris M. Ravin, Clarence C. Reed, Frederic Renfert, W. H. Reynolds, E. E. Richards, Thomas Robins, Chalfant Robinson, Edward J. Rosenthal, Alfred Rossiter, Harvey J. Rutherford.

George C. St. John, Aaron M. Sakolski, L. M. Salladay, William D. Sargent, Arthur E. Sauvigne, George G. Sawyer, Ira Schaefer, W. A. Schleicher, Alfred C. Schmidt, Perry L. Schneider, Samuel Scoville, Jr., E. H. Scull, Norman W. Sederberg, Richard O. Shimer, James S. Smith, Ogden Kellogg Smith, Ralph Pierson Smith, Arthur L. Smythe, John A. Sontag, George F. Stammler, K. I. Stubblefield, Richard D. Sutton, Blair K. Swartz.

Edward N. Taylor, James Voorhees Thompson, Willard L. Thorp, Neil K. Tilton, J. W. Tralor, Alfred R. True, A. S. K. Tyengar.

Tom Vanosdall, Charles Vezin, Louis M. Voges.

Edward Wagner, Fred H. Walker, Francis J. Walsh, George H. Weinberg, Edward A. Weiss, Leslie Weldon, Geo. D. Welles, G. H. West, James W. Wickenden, Charles D. Williams, David McK. Williams, Jay Jerome Williams, John M. Williams, Alfred L. Wise.

Hiram G. Young.

Daniel J. Zutt.

Reviews of New Books

Insect Life, Anatomy, Geology, Conservation, and Indian Lore

CITIES OF WAX. *By Julie Closson Kenly. Illustrated by Henry C. Kenly. D. Appleton-Century Company.*

HERE is an alluring, vividly—one might say enthusiastically—written account of the activities of the honey-bee colony, addressed primarily to children from say ten years upward but likely to prove enticing also to their parents. In the main accurate and where the author is inclined to stray beyond the limits of the known, prefaced by such safeguarding statements as "and now, shall we say she cocks her ears and listens? She has no ears to cock and the scientists have grave doubts that she has any sense of hearing. . . . But from what follows it would seem that perhaps she may hear with her mind instead of her ears." If one were inclined to be critical, one might cite instances where there are real inaccuracies—in the text as well as in the illustrations—but a listing of these would be disproportionate in a brief review and might deter a reader from the purchase of a volume which, notwithstanding the excessive literature on the subject, is commendable as an instructive and entertaining account of a significant phase of nature.

—HERBERT F. SCHWARZ

THE HUMAN FOOT: ITS EVOLUTIONARY DEVELOPMENT, PHYSIOLOGY AND FUNCTIONAL DISORDERS. *By Dudley J. Morton. Columbia University Press, 1935.*

DR. DUDLEY J. MORTON, associate professor of anatomy at the College of Physicians and Surgeons, Columbia University, and research associate in the department of comparative anatomy at the American Museum has just published a valuable work on the human foot. The first three chapters trace the earliest history of the fore and hind feet of vertebrates, as the animals learned first how to crawl, then to run, and later to climb trees. The author's detailed comparisons of the human foot with those of the lower primates leads him to the view that the human foot represents a made-over ape foot, which in earlier ages was fitted for grasping the branches of trees. This general viewpoint has in turn led the author to a new and original appreciation of the ways in which the human foot now functions and to some of the reasons for its functional disorders.

It was partly in order to secure comparative anatomical material for Doctor Morton's studies on the human foot that the Columbia University-American Museum African Expedition of 1929-31 was planned and carried through.

Doctor Morton's dedication of his book to the curator of comparative anatomy in the American Museum is a gracious acknowledgment of such assistance as the department was able to give to this fruitful line of investigation.

—WILLIAM K. GREGORY

THE ADVENTURES OF SAJO AND HER BEAVER PEOPLE. *By Grey Owl. London: Lovat Dickson and Thompson, Ltd.; New York, Scribners. Pp. 256. Illustrated from photographs and drawings. 1935.*

SOME of those who had read Grey Owl's autobiographical work *Pilgrims of the Wild*, wished that he might write about beavers for children. No one else could tell the story so well, and base it on such a wealth of experience and observation. No other writer had the matter so much at heart, or so earnestly wished to win good will for the creatures of the forest. Whether such advice prevailed, or Grey Owl came to write this story as the logical result of the workings of his mind, perhaps he himself could hardly say, but we have the *Sajo and Her Beaver People* the sort of book we had hoped to see, but did not have the vision to imagine.

It is a simple tale, so far as the plot is concerned. Sajo and Shapian, young Indian children are surprised one day when their father brings home a couple of very young beavers—beaver kittens as they are called—which he had found under circumstances which made it necessary to take them, to save them from perishing. The little creatures were named Chilawee and Chickanee, which means Big Small and Little Small. They soon became accustomed to their new environment and the children were devoted to them. There is much to be said about their work and play, their individual peculiarities, their behavior under all sorts of circumstances. All this is based on acutal observation, and constitutes, we may suppose, the best account of the behavior of young beavers on record.

There comes a time when the father has to go away to earn a living, and he is obliged to raise some money to provide for the children. He therefor cannot neglect a chance to sell Chikanee to a trader for a good price, and the little animal finally reaches a menagerie in an amusement park in a town. The children sorrowing over their loss, decide to go forth and try to recover their lost beaver, and eventually, after many adventures, they are successful. They pass through a terrible forest fire, and opportunity is taken to dwell on the fearful results of carelessness. They are helped by a kindly missionary and an Irish policeman, and eventually by the proprietor of the Zoo, who is touched by their story, and voluntarily surrenders the beaver which had cost him fifty dollars. It is all very charmingly told, and any one young or old, who takes up the book will be loath to put it down until it is finished. The style is unique yet we think somewhat of Hans Christian Anderson, who similarly had a double purpose to tell a story and teach a lesson.

At the end of the book we are told how winter is approaching, and the children take the beavers back to the lodge whence they came, and bravely but sorrowfully bid them farewell. "Sajo held the little beavers close, just for a moment, and whispered into the small black ears: Good-bye, Chilawee; good-bye Chickanee, my Little Brothers. Don't let's forget . . . . *ever*. And she let them go. She followed them to the very edge of the water, where she stood watching them as they floated off. On they swam, on across their own home pond, their two round chubby heads side by side, as they had always been; sturdy Chilawee, jovial, wayward and full of whims; gentle Chickanee, wistful, winsome, and affectionate. A few more minutes and they would be gone. And no matter how big they might grow to be, in one tender, loving little heart they would still remain two tiny, helpless baby beavers."

—T. D. A. Cockerell

Fish and Game—Now or Never. *By Harry Bartow Hawes. D. Appleton-Century Co. 332 pp. $3.00.*

The author has designated this book "a challenge to American sportsmen on wild-life restoration." It is all of that and the challenge need not be restricted to sportsmen but should be accepted by everyone who loves the out-of-doors.

Former Senator Hawes calls attention to the rapid disappearance of many game species, and to the encroachments of man upon the dwindling public domain, and emphasizes the urgent need of action if wild-life is to be saved before it is too late. With this thesis there should be no disagreement; it is high time that constructive conservation measures be employed. The importance of this book rests not upon the presentation of data and argument for the need of conservation, but rather upon the strange philosophy of the author when he attempts to interpret. It is to be hoped that this narrow point of view is not held by the rank and file of sportsmen.

Early in the book the author states that "the hunter is the best defender of game" and throughout reiterates this text. As a counterpoint to this theme of sportsmen righteousness in Hawes' threnody on the disappearance of game is the constant criticism of the "sentimentalist." The "sentimentalist" is not defined, but by inference he is anyone who differs with the concept of conservation held by the author. The "sentimentalist" is a "boudoir theorist"; he is rated with the forces of destruction along with the crow, mongrel dog, "game bootlegger," and hawk, under the category, "the organizations of sentimentalists which in numerous cases have a confused idea of true conservation." It is very obvious that the author has a grudge against "sentimentalists" and the expression of this is no great asset to his cause.

Lack of space forbids extended comment upon the wild-life rights of the sportsman versus those of the "sentimentalist," but when a spokesman for the hunting fraternity stakes out claims of the magnitude outlined by Hawes, one is moved to protest. The nature lover is as much entitled to his fair share of our wild-life heritage, taken by eye and ear if he so desires, as is his "sportsman" critic who prefers the media of trigger-finger and stomach. Between the outright "game hog" and the extreme "sentimentalist" who would take wild-life under no circumstances, there lies a great gamut, and, as a national resource, wild-life belongs to everyone. If sportsmen can take their just share of game without depriving other outdoor men of an equally just share of wild-life appreciation, there will be no criticism. If some one announces that the rights of the sportsman are paramount, that every animal that interferes with game should be exterminated, and that every man who differs with this thesis is a sentimental ignoramus, then some resentment can be expected. Mr. Hawes seems to have had some such naïve idea when he wrote his book. In one section he admits, "There should be no difference between the sportsman who shoots edible game birds and those sentimentalists who are interested primarily in birds that have no food value" but he forgets this fair assumption on most of his pages.

Sportsmen have done much for game, even more than that, many of them have stood firmly for the larger concept of conservation of wild-life. Most of them will admit that the abuse of the hunting privilege has been a primary factor in the shortage of game species, and in this respect the hunter has not been the best friend of wild game. Many sportsmen, too, have an inherent love of wild-life. Although moved by the entirely reasonable desire to bring back something in the hunting bag, these individuals have an appreciation of the out-of-doors which is not completely predicated upon seeing their wild-life over the sights of a gun. In brief, many a sportsman is a "sentimentalist" or, to turn the phrase about, many a "sentimentalist" is a sportsman. There is no incompatibility between the two categories and any attempt to set them up in rival camps, such as is made by Hawes, not only discloses a poor grasp of facts but does a disservice to conservation.

The salvation of wild-life will be best achieved by a consolidation of forces. The sportsmen need the nature lovers, the naturalists, and even the "sentimentalists" and, conversely, the non-sporting conservation groups should welcome the support of sportsmen. The Hawes credo of conservation states, "In its broadest sense the conservation of wild life embraces the conservation of the related sources of field, forest and water. Its problems deal with the biological aspects of the discussion and perpetuation of these natural resources, and the wise use of the species therein and their adaptation to human welfare." Overlooking the anthropocentric twist implied in "their adaptation to human welfare," the reader will concede that this statement postulates the broad base upon which conservation must stand. What a pity that Hawes' treatment of the subject departs from these principles, that so many passages pose the hunter as a Pharisee. It is difficult to believe that the majority of sportsmen will take pride in this exposition of their case which on its merits deserves something better than propaganda of this type.

The book is not easy reading, the development of the subject suffers from rambling digression, and at times it is difficult to discover whether the primary purpose is autobiography or conservation. Nevertheless, the sportsman and the nature student should read *Fish and Game—Now or Never* in order to learn of the forces working upon conservation.—H. E. Anthony

Along the Hill. *By Carrol Lane Fenton. 96 pp. with illustrations by the author. A John Day book, in association with Reynal and Hitchcock. 1935.*

This little book is one of the three John Day Nature Handbooks for beginners entitled: "Along the Shore" by Eva L. Butler; "Along the Brook" by Raymond T. Fuller; and "Along the Hill" by Carrol Lane Fenton.

While the title "Along the Hill" may sound a bit strange, it is in fact a simple story of the more common things found on our earth and how they came to be. Inside the cover there is a brief story about the author, followed by two pages devoted to listing the topics which are discussed in the body of the book. There are fifty-one of them. Each topic with its illustration occupies a page or two. In addition to the hill's story there are topics which deal with the rocks of the earth such as sandstone, conglomerate, clay and shale, limestone, granite, basalt, etc.; some of the more common minerals like quartz, calcite, gypsum, and pyrite, as well as brief accounts of the results of physical and chemical forces at work on the earth, such as cross-bedding, normal faults, sand dunes, pinnacles, ripple marks, mud cracks and concretions. What fossils are appears on page 36. Then follow topics which include the principal living and fossil forms of life such as "forams," sponges, corals, moss animals, wing shells and clams, snails, horn shells, sea lilies, trilobites, coal plants and petrified forests. There are also a series of topics dealing with geologic features of a varied nature, such as Sea Bottom to Land, The Ice Age, Till, The Spring, The Creek, Heat and Cold, Worn-Down Mountains and Earth's Ages, etc.

Short simple sentences have been used throughout the book. Technical terms have been omitted. The topics discussed have been presented in a clear, accurate, and convincing manner. The book will slip easily into the coat pocket and should be of service to Boy Scouts, hikers, and those who are unfamiliar with the earth and its history.

—Chester A. Reeds

Heels, Wheels and Wire. *The Story of Messages and Signals. By Frances Rogers and Alice Beard. 265 pp., 68 illus. Stokes Co., New York, 1935.*

The Pony Express Goes Through. *An American Saga Told by Its Heroes. By Howard R. Driggs, Ph.D. 208 pp., 8 color plates, numerous line drawings. Stokes Co., New York, 1935.*

These two books are different but we are justified in reviewing them jointly because they supplement each other. The first is a readable account of achievement in communications, the title noting three of the chief methods for speeding up messages. A table is given dating the outstanding advances, as carrier pigeons 2000 B.C., postal routes 560 B.C., printing 1446 A.D., lead pencils 1565, telegraph 1844, telephone 1876, air mail 1911, public broadcasting 1920, radio telephone and television 1927, etc. Reading the full table will be worth the price of the book. The descriptions are concise but understandable and the illustrations appealing and sometimes amusing.

The Pony Express is not so much a history of that method of carrying mail across the plains as a narration of adventures and sketches of personalities. The reader rides with the mail, thus acquiring a feel of the country, its great open spaces, and the spirit of the times. Everyone will be moved by the story of one impatient horse, breaking away before the rider could mount, and bringing the mail in on time. One unique feature is a group of eight color plates, from paintings by William H. Jackson who began his career as artist and photographer of western life in 1866. These paintings are true pictures of wagon trains, pony express stations, and western landscapes. Everyone familiar with the great west will enjoy these pictures and the narratives accompanying them.

—Clark Wissler

Tales of Sint Sink. *By Charlotte E. Merriman. Illus. by Lyman A. Langdon. Pub. by the Board of Education of Port Washington, N. Y. pp. 258. Price $2.50.*

"Tales of Sint Sink" is written for "boys and girls and certain older folks who wonder why and where and when" about the place in which they live. It tells, in a fascinating way, the story of that neck of land between Manhasset Bay and Hempstead Harbor on the north shore of Long Island. Today this promontory contains the villages of Plandome, Port Washington, and Sands Point.

Because so many young people in the Port Washington Schools asked so many questions about their village, Miss Merriman, principal of the Main Street School, set out to collect all of the material she could find that she might piece together this interesting story. The task involved patient searching through ancient documents that had for generations lain in the dust of local garrets. Town records were carefully studied and Indian deeds brought to light.

The product of her effort is embodied in an attractive volume of more than 250 pages, which unfolds the events of local history from Indian days to the present. The book is divided into four major parts, which are subdivided into chapters. These are cleverly tied together so that from beginning to end there is unbroken continuity of action. Throughout the book are many marginal notes containing facts pertinent to the text. Again these give the sources from which the author obtained her information.

In part one, entitled "Red Men Lived Here Long, Long Ago" we find the story teller relating to a play Indian Chief a wonder tale of long ago. She is telling of "a real true Indian lad who walked about these very shores." As the story continues we read of the adventures of this Indian boy, who belonged to the Matinecock tribe and lived near the rocky shores of Sint Sink, which was the Indian name for the territory later known as Cow Neck and today known as Plandome, Port Washington and Sands Point.

The story tells how Eagle Eye, the Indian lad, saw the coming of a great canoe—how he carried the word to his tribe, and how the Indians welcomed the strange pale-faced people who carried sticks that belched forth lightning and thunder.

A wealth of detail tells just how the Indians lived, where they built their wigwams, and what materials they used.

Part two tells of the first settlers; of their difficulties in establishing themselves in this new land; of their contact with the red-skinned natives. We learn of the trouble between the early Dutch and English settlers; of threatened attacks by the Indians from the mainland.

So the story continues and we see the Dutch defeated and the English becoming prosperous in their new home. Then come troubles with the mother country and after that the terror of night raids from whaleboat-men off Long Island Sound.

The story continues through the Civil War and the dawn of the present century.

Throughout it is presented in a lively manner with much detail. We see just how these early folk reaped a living from the environment in which they lived.

The book was written primarily for young people between ten and twelve years of age. It is used as a history text in the sixth grade schools of Port Washington. Every chapter contains leads that suggest activities for the children, inspire group discussions, and present many possibilities for dramatization.

Many attractive illustrations in black and white and maps, by Lyman A. Langdon, principal of the Flower Hill School, add greatly to its attractiveness.

There is a bibliography but unfortunately, no index.

This work is particularly interesting because of the fact that the make-up and presswork were done by the students of the Port Washington Junior High School printing classes under the leadership of Carleton T. Pierce.

Here is a worthy contribution to local history and one that should be of interest to grown-ups as well as younger folks. It would make an excellent Christmas gift for anyone with the spark of curiosity as to the why, where, and when of other days.—Robert R. Coles

Museum Animal Theatres

ANIMAL THEATRES reproduced from the lifelike exhibits in the Museum—four of these fascinating theatres to be set up which will prove a delight to every boy and girl possessing them. It will be an absorbing work to cut out and arrange these theatres—hours of anticipation. What a supreme delight would these have been to the young people in Little Women! The animals may be moved about and no paste is necessary. It is a natural history exhibit that can be staged in any home. The backgrounds are taken from the exhibits in the Museum and the animals modeled on those seen in the groups.

Sold only in sets of four for $1.00
Including postage, east of Chicago $1.14
Including postage, west of Chicago, including all of U. S. possessions $1.32

No. 1 represents the African Lion [*Felis leo*]. It is a scene on the edge of the mysterious veldt near Nairobi, British East Africa. The king of beasts is waiting, with his family, under a tree for the dusk to descend prior to their sally for their evening meal.

No. 2 represents the Bengal Tiger [*Felis tigris*] in the Kheri forest in India. The tigress leads her cubs to the stream to drink and through the reeds and trees appears the lordly male. This represents one of the groups collected for the American Museum by the Vernay-Faunthorpe Expedition.

No. 3 is the Gorilla [*Gorilla savages*]. Here we see the Lake Kivu region of the Belgian Congo with the slope of Mt. Mikena showing in the purple sunset. This great animal was carefully studied by Carl E. Ackley on his many trips to Africa and from this theatre one will glean many interesting facts about a creature that has long been too little known.

No. 4 is the African Elephant [*Elephas africanus*]. The world's largest game animal is seen in a beautiful setting near Lake Paradise, British East Africa. The group is dispersing to cover after having been startled and the great bull wheels about to charge the enemy.

Each theatre when set up measures 18″ wide, 10″ high and 8″ deep. Maps and descriptive material accompany each set. Because of their artistic colors, these animal groups make unusual decorations in the home as well as being splendidly adapted for class room use and above all for the playroom of every child. Parcel post charges additional. The weight packed for transportation is 3 lbs.

Address all orders to
THE BOOK SHOP, THE AMERICAN MUSEUM OF NATURAL HISTORY
77th Street and Central Park West, New York City

THE WILSON H. LEE COMPANY
ORANGE (NEW HAVEN), CONN.

CHILDREN'S BOOKS *by* MUSEUM AUTHORS *and others of good standing*

for sale by THE AMERICAN MUSEUM OF NATURAL HISTORY

Author	Title	Price
Abbot, Charles Greely	Everyday Mysteries	$2.00
Akeley, Carl and Mary Jobe	Lions, Gorillas and Their Neighbors	2.50
Boy Scout Book of True Adventure		2.50
Bronson, Wilfrid S.	Fingerfins	2.00
	Paddlewings	2.00
Cory, Harper	Animals All	1.75
D'Aulaire, Ingri and Edgar	Children of the North Lights	2.00
	The Conquest of the Atlantic	1.75
Disraeli, Robert	Seeing The Unseen	2.00
Ditmars, Raymond and Carter Helene	The Book of Zoögraphy	2.00
Douglas, Robert Dick, Jr., Martin, David R., Jr., Oliver, Douglas L.	Three Boy Scouts in Africa	1.75
Ewers, Hanns Heinz	The Ant People	3.00
Fabre's Book of Insects		2.00
Fenton, Carrol Lane	The World of Fossils	2.00
Fisher, Clyde and Langham, Marion	Nature Science:	
	Book I. World of Nature	.96
	Book II. Ways of the Wild Folk	.96
	Book III. Our Wonder World	.96
	Book IV. In Field and Garden	.96
Green, Fitzhugh	Roy Andrews—Dragon Hunter (A book for boys about Dinosaurs and Bandits)	1.75
Harrington, Isis L.	Komoki of the Cliffs	1.20
Hathaway, Esse	Romance of The American Map	2.00
Hillyer, V. M.	A Child's Geography of the World	2.00
Hornaday, William T.	Tales From Nature's Wonderlands	$2.50
Howes, Paul Griswold	Backyard Exploration	3.00
Johnson, Gaylord	The Stars for Children	1.50
Johnson, Osa Helen	Jungle Babies	1.75
Knight, Charles R.	Before the Dawn of History	2.50
La Monte, Francesca and Welch, Micaela	Vanishing Wilderness	2.50
Maeterlinck, Maurice	The Children's Life of the Bee	2.00
Mann, Lucile Q.	From Jungle to Zoo	2.00
Mann, Paul B., and Hastings, George T.	Out of Doors, A Guide to Nature	2.00
Martin, John and Youmans Roy	How to Make Sky Pictures	1.00
Mathews, F. Schuyler	The Book of Wild Flowers for Young People	3.00
McCreery, James Lindsay	Exploring the Earth and Its Life	2.00
Olcott, William Tyler	The Book of the Stars for Young People	3.00
Patch, Edith M.	Holiday Hill	2.00
	Holiday Pond	2.00
Reed, Maxwell W.	The Sea for Sam	3.00
	The Earth for Sam	3.50
	The Stars for Sam	3.00
Robinson, W. W.,	Animals in the Sun	2.00
Schweinitz, Karl de	Growing Up	1.75
Stefansson, Vilhjalmur and Violet Irwin	Kak	1.50
Washburne, Carleton and Heluiz	Story of Earth and Sky	3.50

Address orders to The Book Shop

THE AMERICAN MUSEUM OF NATURAL HISTORY

77th STREET AND CENTRAL PARK WEST :: :: :: NEW YORK, N. Y.

Remittances must accompany all orders—Include 10 cents per volume for postage